

AD-A274 764



AD _____

2

CONTRACT NO.: DAMD17-92-C-2066

TITLE: Evaluation of Biomonitoring Systems for Assessment of Contaminated Waters and Sediments at U.S. Army Installations - Fort Detrick Wastewater Treatment Plant Effluent Biomonitoring Study

PRINCIPAL INVESTIGATOR: Dennis T. Burton, Ph.D.

CO-INVESTIGATOR: Steven D. Turley, M.S.

PI ADDRESS: University of Maryland System
Agricultural Experiment Station
Wye Research and Education Center
P.O. Box 169
Queenstown, MD 21658

DTIC
SELECTE
JAN 13 1994
S B D

REPORT DATE: July 30, 1993

TYPE OF REPORT: Annual Report (Report Period - June 18, 1992 to July 30, 1993)

PREPARED FOR: U.S. Army Medical Research and Development Command
Fort Detrick
Frederick, Maryland 21702-5012

DISTRIBUTION STATEMENT: Approved for Public Release
Distribution Unlimited

The views, opinions and/or findings contained in this report are those of the author(s) and should not be construed as an official Department of the Army position, policy or decision unless so designated by other documentation.

94-01446



17985

94 1 12 040

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
<small>Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.</small>				
1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE July 30, 1993	3. REPORT TYPE AND DATES COVERED Annual Report (6/18/92 - 7/30/93)		
4. TITLE AND SUBTITLE Evaluation of Biomonitoring Systems for Assessment of Contaminated Waters and Sediments at U.S. Army Installations - Fort Detrick WWTP Effluent Biomonitoring Study.			5. FUNDING NUMBERS DAMD17-92-C-2066	
6. AUTHOR(S) Dennis T. Burton and Steven D. Turley				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) The University of Maryland System Agricultural Experiment Station Wye Research and Education Center P.O. Box 169 Queenstown, MD 21658-0169			8. PERFORMING ORGANIZATION REPORT NUMBER WREC-93-B6	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army Medical Research and Development Command Ft. Detrick, Frederick, MD 21702-5012			10. SPONSORING/MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES				
12a. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited.			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) Quarterly biomonitoring tests were performed for one year on composite effluent samples taken from the Ft. Detrick (Frederick, MD) wastewater treatment plant. The cladoceran (<i>Ceriodaphnia dubia</i>) and fathead minnow (<i>Pimephales promelas</i>) acute 48-h LC50 tests were used to evaluate the toxicity of the effluent for two quarters. The cladoceran 7-d survival and reproduction test and the fathead minnow 7-d survival and growth tests were used for two quarters. The effluent was not toxic to the cladoceran or fathead minnow when tested in both acute and chronic bioassays. One priority pollutant analysis was conducted on a composite effluent sample. The analysis showed that four (Cu, Pb, Ni, and Zn) of 12 heavy metal priority pollutants were present in the effluent. The concentrations of the four heavy metals, with the exception of lead for chronic exposure, were below the U.S. EPA numerical water quality criteria for acute and chronic toxicity of the metals to freshwater organisms. The freshwater chronic criteria value for lead is 3.2 ug/L; 6 ug/L were found in the effluent sample. Two volatile organics (bromodichloromethane and dibromochloromethane) were also detected. Both halomethanes were well below the U.S. EPA numerical water quality criteria for acute toxicity to freshwater organisms; no				
14. SUBJECT TERMS Biomonitoring, bioassays, priority pollutants, acute toxicity, chronic toxicity, cladoceran, <i>Ceriodaphnia dubia</i> , fat-head minnow, <i>Pimephales promelas</i> , wastewater treatment plant, WWTP.			15. NUMBER OF PAGES 176	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT Unclassified	

13. ABSTRACT (Continued)

criterion is available for chronic exposure to halomethanes. No semi-volatile organics, pesticides/PCBs or herbicides were detected.

FOREWORD

Opinions, interpretations, conclusions, and recommendations are those of the authors and are not necessarily endorsed by the U.S. Army.

- () Where copyrighted material is quoted, permission has been obtained to use such material.
- () Where material from documents designated for limited distribution is quoted, permission has been obtained to use the material.
- (✓) Citations of commercial organizations and trade names in this report do not constitute an official Department of the Army endorsement or approval of the products or services of these organizations.
- (✓) In conducting research using animals, the investigator(s) adhered to the "Guide for the Care and Use of Laboratory Animals of the Institute of Laboratory Animal Resources, National Research Council (NIH Publication No. 86-23, Revised 1985).
- () In conducting research utilizing recombinant DNA technology, the investigator(s) adhered to current guidelines promulgated by the National Institutes of Health.

Denise T. Burton
Principal Investigator's Signature

10-6-93
Date

DECLASSIFIED

Accession For

TYPE	CLASS	<input checked="" type="checkbox"/>
DATE	FILE	<input type="checkbox"/>
NUMBER	FILED	<input type="checkbox"/>
JAN 1964		

BY

RECEIVED

1964

DATE

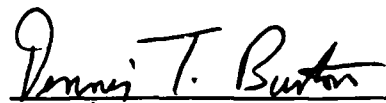
A-1

Certification of Technical Data Conformity (May 1987)

The contractor, The University of Maryland System, hereby certifies that, to the best of its knowledge and belief, the technical data delivered herewith under Contract No. DAMD17-92-C-2066 is complete, accurate, and complies with all requirements of the contractor.

Date: August 6, 1993

Name and Title of Certifying Official:


Dennis T. Burton, Ph.D
Senior Research Scientist

EXECUTIVE SUMMARY

Quarterly biomonitoring tests were performed for one year on composite effluent samples taken from the Ft. Detrick (Frederick, MD) Wastewater Treatment Plant (WWTP). The cladoceran (Ceriodaphnia dubia) 7-d survival and reproduction test and the fathead minnow (Pimephales promelas) 7-d survival and growth test were used to evaluate the toxicity of the effluent during the first and second quarters. The cladoceran and fathead minnow acute 48-h LC50 tests were used during the third and fourth quarters. One general water quality and priority pollutant analysis was conducted on the first quarterly composite effluent sample.

The Ft. Detrick WWTP effluent was not toxic to the cladoceran or fathead minnow when tested in both chronic and acute bioassays. The two quarterly 7-d chronic tests with the cladoceran showed that the effluent did not cause appreciable mortality or reduction in neonate production. Likewise, no mortality or statistically significant ($\alpha = 0.05$) reduction in growth occurred to fathead minnow during the two quarterly 7-d tests. No acute 48-h LC50s were obtained for the cladoceran or fathead minnow during two quarterly tests.

One priority pollutant analysis of the effluent showed that four (Cu, Pb, Ni, and Zn) of 12 heavy metal priority pollutants (Section 307 toxic pollutants) were present in the effluent. The concentrations of the four heavy metals, with the exception of lead for chronic exposure, were below the EPA numerical water quality criteria for acute and chronic toxicity to freshwater organisms. The EPA freshwater chronic criterion value for lead is 3.2 $\mu\text{g/L}$; 6 $\mu\text{g/L}$ were found in the effluent sample. Two volatile organics (bromodichloromethane and dibromochloromethane) were also found. Both halomethanes were well below the EPA numerical water quality criterion for acute toxicity to freshwater organisms; no criterion is available for chronic exposure to halomethanes. No semi-volatile organics, pesticides/PCBs or herbicides were detected.

ACKNOWLEDGEMENTS

We thank Mr. Ted Hahn, Chief, Sanitation Branch, Operations and Maintenance Division, Ft. Detrick, Frederick, MD for his timely logistical support during the study. We also thank Mr. Tommy R. Shedd, Contracting Officer's Representative, for his continual support and constructive help during the study. We acknowledge the Research Methods Branch/Health Effects Research Division of the U.S. Army Biomedical Research and Development Laboratory (USABRDL) for supporting the study through U.S. Army Contract No. DAMD17-92-C-2066.

TABLE OF CONTENTS

FORWARD.....	1
CERTIFICATION OF TECHNICAL DATA CONFORMITY.....	2
EXECUTIVE SUMMARY.....	3
ACKNOWLEDGEMENTS.....	4
TABLE OF CONTENTS.....	5
LIST OF TABLES.....	7
1. INTRODUCTION.....	8
2. OBJECTIVES OF STUDY.....	9
3. MATERIALS AND METHODS.....	10
3.1 Biomonitoring Studies.....	10
3.1.1 General Test Considerations.....	10
3.1.2 Culture and Maintenance of Test Organisms..	11
3.1.2.1 Cladocerans.....	11
3.1.2.2 Fathead Minnows.....	11
3.1.3 Routine Water Quality.....	12
3.1.4 Test End Points and Data Analyses.....	12
3.2 Effluent Chemical Analyses.....	13
4. RESULTS AND DISCUSSION.....	15
4.1 Biomonitoring Studies.....	15
4.1.1 Chronic Tests.....	15
4.1.2 Acute Tests.....	16
4.1.3 Reference Toxicant Tests.....	16
4.2 Effluent Chemical Analyses.....	16
5. CONCLUSIONS.....	18
6. LITERATURE CITED.....	19
APPENDIX 1. CLADOCERAN 7-D SURVIVAL AND REPRODUCTION TEST CONDUCTED ON FT. DETRICK WWTP EFFLUENT (FIRST QUARTER TEST).....	A1-1
APPENDIX 2. FATHEAD MINNOW 7-D SURVIVAL AND GROWTH TEST CONDUCTED ON FT. DETRICK WWTP EFFLUENT (FIRST QUARTER TEST).....	A2-1

APPENDIX 3.	CLADOCERAN 7-D SURVIVAL AND REPRODUCTION TEST CONDUCTED ON FT. DETRICK WWTP EFFLUENT (SECOND QUARTER TEST).....	A3-1
APPENDIX 4.	FATHEAD MINNOW 7-D SURVIVAL AND GROWTH TEST CONDUCTED ON FT. DETRICK WWTP EFFLUENT (SECOND QUARTER TEST).....	A4-1
APPENDIX 5.	CLADOCERAN 48-H SURVIVAL TEST CONDUCTED ON FT. DETRICK WWTP EFFLUENT (THIRD QUARTER TEST).....	A5-1
APPENDIX 6.	FATHEAD MINNOW 48-H SURVIVAL CONDUCTED ON FT. DETRICK WWTP EFFLUENT (THIRD QUARTER TEST).....	A6-1
APPENDIX 7.	CLADOCERAN 48-H SURVIVAL TEST CONDUCTED ON FT. DETRICK WWTP EFFLUENT (FOURTH QUARTER TEST).....	A7-1
APPENDIX 8.	FATHEAD MINNOW 48-H SURVIVAL CONDUCTED ON FT. DETRICK WWTP EFFLUENT (FOURTH QUARTER TEST).....	A8-1
APPENDIX 9.	INITIAL GENERAL WATER QUALITY AND PRIORITY POLLUTANT ANALYSIS OF THE FT. DETRICK WWTP EFFLUENT.....	A9-1
APPENDIX 10.	RETEST OF 14 HEAVY METALS IN THE FT. DETRICK WWTP EFFLUENT.....	A10-1
APPENDIX 11.	RETEST OF THREE HEAVY METALS IN THE FT. DETRICK WWTP EFFLUENT.....	A11-1

LIST OF TABLES

1.	SUMMARY OF EPA TEST CONDITIONS AND TEST ACCEPTABILITY CRITERIA FOR THE CLADOCERAN 7-D CHRONIC TOXICITY SURVIVAL AND REPRODUCTION TEST.....	21
2.	SUMMARY OF EPA TEST CONDITIONS AND TEST ACCEPTABILITY CRITERIA FOR THE FATHEAD MINNOW 7-D CHRONIC TOXICITY LARVAL SURVIVAL AND GROWTH TEST.....	23
3.	SUMMARY OF EPA TEST CONDITIONS AND TEST ACCEPTABILITY CRITERIA FOR THE CLADOCERAN 48-H ACUTE TOXICITY TESTS...	25
4.	SUMMARY OF EPA TEST CONDITIONS AND TEST ACCEPTABILITY CRITERIA FOR THE FATHEAD MINNOW 48-H ACUTE TOXICITY TESTS.....	27
5.	SUMMARY OF THE 48-H LC50 VALUES AND ASSOCIATED 95% CONFIDENCE LIMITS OF THE CLADOCERAN (<24 H OLD) AND FATHEAD MINNOW (<30 D OLD) EXPOSED TO THE REFERENCE TOXICANT POTASSIUM CHLORIDE.....	29
6.	SUMMARY OF ALL QUANTIFIABLE PARAMETERS IN THE FT. DETRICK WWTP EFFLUENT.....	30

SECTION 1

INTRODUCTION

The U.S. Army Biomedical Research and Development Laboratory (USABRDL) has the responsibility for assessing the possible environmental hazards associated with munitions-unique pollutants released during manufacturing and testing activities, deployment in the field, and environmental contamination at U.S. Army installations. In 1992 the Maryland Department of the Environment directed the Operations and Maintenance Division at Ft. Detrick to conduct a toxicity evaluation of the Ft. Detrick Wastewater Treatment Plant (WWTP) effluent (Outfall 001; NPDES Permit No. MD 0020877). The evaluation was performed under contract from USABRDL to the University of Maryland as part of their evaluation of biomonitoring systems for the assessment of contaminated waters and sediments.

The wastewater treated at the Ft. Detrick WWTP is primarily from domestic sources, light industrial, and medical/biological laboratories. Approximately 30 to 35 percent of the flow is from the medical/biological laboratories. Ft. Detrick has a strict policy of collecting hazardous wastes at the point of generation with subsequent disposal by off-site vendors. As a result, toxic substances discarded to the Ft. Detrick WWTP should be minimal. The treated wastewater is generally of high quality. Biological oxygen demand (BOD) ranged from a low of 0 mg/L to a high of 6.0 mg/L between June 1991 and May 1992. During the same period, suspended solids ranged from 0 mg/L to 7.0 mg/L. The plant has a designed capacity of 2.0 mgd; the annual capacity ranges from 0.75 to 1.2 mgd. Chlorination is used for disinfection followed by dechlorination (sulfur dioxide) of the effluent before discharge (Hahn, 1992).

Quarterly biomonitoring tests were performed for one year on composite samples taken from the Ft. Detrick WWTP Outfall 001. The cladoceran (Ceriodaphnia dubia) 7-d survival and reproduction test and the fathead minnow (Pimephales promelas) 7-d survival and growth test were used to evaluate the toxicity of the effluent during the first and second quarters. The cladoceran and fathead minnow acute 48-h LC50 tests were used during the third and fourth quarters. One general water quality and priority pollutant analysis was conducted on the first quarterly composite effluent sample.

SECTION 2

OBJECTIVES OF STUDY

1. To evaluate the chronic toxicity of the Ft. Detrick WWTP effluent using the cladoceran 7-d survival and reproduction test and the fathead minnow 7-d survival and growth test.
2. To evaluate the acute toxicity of the Ft. Detrick WWTP effluent using the cladoceran and fathead minnow 48-h LC50 test.
3. To determine the general water quality of the effluent and to quantify any priority pollutants present in the effluent.

SECTION 3
MATERIALS AND METHODS

3.1 Biomonitoring Studies

3.1.1 General Test Considerations

Two quarterly 7-d chronic biomonitoring tests were conducted during the periods October 26 - November 2, 1992 and January 11 - 18, 1993. Two quarterly acute tests were conducted April 5 - 7, 1993 and July 12 - 14, 1993. The cladoceran Ceriodaphnia dubia and the fathead minnow Pimephales promelas were used for all quarterly biomonitoring tests.

Three composite samples, which were collected on days 1, 3, and 5, were used for each quarterly 7-d chronic test for both species. One composite sample was used each quarter for the acute cladoceran and fathead minnow tests. Twenty-four hour composite samples of effluent (Outfall 001; NPDES Permit No. MD 0020877) were collected by Ft. Detrick WWTP personnel as follows. A 750 mL sample of effluent was taken at hourly intervals over a 24-h period and placed in a 19 L polycarbonate carboy which was held on ice in an insulated container. All 24-h composite sampling was initiated at 0800 h and concluded the following day at 0700 h. The composite effluent sample was transported on ice the morning the collection was completed in an insulated container to the University of Maryland Wye Research and Education Center (UMD/WREC) Toxicology Facility (Queenstown, MD) where the studies were conducted. Upon receipt of the material, the effluent was stored at 4°C. The effluent was warmed to the test temperature of 25°C before being used in a test. Twenty-four hour composite sample logs and chain of custody logs for all samples were completed and are presented in Turley (1992, 1993a, 1993b, and 1993c).

All tests were initiated the day the effluent was collected. The effluent was not aerated prior to the start of a test; however, if the dissolved oxygen concentrations dropped to 40% saturation by the end of the first 24 h of a test, the samples were aerated during the next 24-h period. The dilution water for the cladoceran tests was 20% Perrier; 80% RO water amended with selenium ($2 \mu\text{g Se/L as Na}_2\text{SeO}_3$) as recommended by Winner (1989). UMD/WREC non-chlorinated, deep well water was used as dilution water for the fathead minnow tests.

The chronic toxicity of the effluent was evaluated by the EPA short-term methods for estimating the chronic toxicity of effluents and receiving waters to freshwater organisms (Weber et al., 1989). Neonate cladoceran <24 h old were used in the 7-d survival and reproduction test. Ten-day old fathead minnow were

used in the 7-d survival and growth test. The chronic toxicity test conditions for the cladoceran and fathead minnow are summarized in Tables 1 and 2, respectively.

Neonate cladoceran <24 h old and larval fathead minnow <24 h old were used in the 48-h acute tests. The organisms were tested by the definitive static renewal toxicity procedures recommended by the U.S. Environmental Protection Agency (EPA) for measuring the acute toxicity of effluents to freshwater and marine organisms (Weber, 1991). The acute toxicity test conditions for the cladoceran and fathead minnow are summarized in Tables 3 and 4, respectively.

EPA quality assurance (QA) practices for effluent toxicity tests, which include all aspects of the test that affect the accuracy and precision of the data, were followed for the acute and chronic tests. In addition to the quarterly toxicity tests described above, 48-h static renewal reference toxicity tests were also conducted on both species exposed to the reference toxicant potassium chloride (KCl) using EPA's acute toxicity test protocols (Weber, 1991). Ongoing in-house reference toxicity tests are routinely used to establish the validity of all effluent toxicity data generated from the toxicity tests. The potassium chloride used in the reference toxicity tests was prepared from ACS reagent grade potassium chloride.

3.1.2 Culture and Maintenance of Test Organisms

3.1.2.1 Cladocerans

The cladoceran was cultured at 25 (\pm 1) °C in 600 mL glass beakers filled with 400 mL of 20% Percier:80% RO water amended with selenium (2 μ g Se/L as Na₂SeO₃) as recommended by Winner (1989). The diet consisted of a mixture of Cerophyl® (Cerophyl Laboratories, Inc., Kansas City, MO) and the green alga, Selenastrum capricornutum, added to the daphnid culture to achieve final concentrations of 120 μ g Cerophyl®/mL and 6.7 x 10⁵ S. capricornutum cells/mL. Starter cultures of C. dubia were obtained from the Center for Lake Superior Environmental Studies, University of Wisconsin - Superior. The cladocerans were cultured under a 16-h light:8-h dark photoperiod (fluorescent lights; 60-85 foot candles at the surface of the culture vessels).

3.1.2.2 Fathead Minnows

Fathead minnow larvae were obtained from the UMD/WREC culture maintained at 25 (\pm 1) °C in UMD/WREC nonchlorinated well water. The culture procedures are similar to those recommend by Peltier and Weber (1985). The UMD/WREC culture was initiated with mature fathead minnows obtained from the U.S. EPA Environmental Monitoring and Support Laboratory - Cincinnati, OH.

Briefly, spawning fish are cultured in fiberglass tanks (2.4 x 0.8 x 0.5 m) containing 0.2 m UMD/WREC well water held at 25 (\pm 1) °C. The spawning adults are fed a diet of frozen brine shrimp (*Artemia* sp.) and TetraMin® staple food (Ramfab Aquarium Products Co., Oak Ridge, TN) twice daily. Excess food is removed daily. Five sets of spawning fathead minnows are maintained in the culture tanks at a ratio of 1 male:3 females. Replacement spawners are rotated at \approx 3-month intervals. Fathead minnow embryos are collected on spawning substrates (10 cm I.D. x 20 cm long PVC pipe sections cut longitudinally in equal portions). Larvae are reared on brine shrimp nauplii (<24 h old) in 20 L aquaria at 25 (\pm 1) °C in UMD/WREC well water. All stages of the fathead minnow are reared under a 16-h light:8-h dark photoperiod (fluorescent lights; 60-85 foot candles at the surface of the culture vessels).

3.1.3 Routine Water Quality

Dissolved oxygen, pH, and conductivity were measured in the 48-h acute tests in one replicate of all treatments at time 0 h and 24 h on day 1 and again at time 0 h and 24 h of day 2 when the test solutions were renewed. Alkalinity, hardness, and temperature were measured in the 48-h acute tests in one replicate of all treatments at time 0 h on day 1 and again at time 0 h and 24 h of day 2 when the test solutions were renewed. The same frequency of measurements for the above parameters were used during the 7-d chronic tests at each 24-h renewal period through day 7. Measurements were made in alternating replicates throughout all tests in both the acute and chronic studies. Routine water quality was determined by procedures given in Standard Methods (APHA et al., 1992). An initial effluent quality measurement log for each effluent sample was completed at the time the toxicity test was initiated at UMD/WREC. The logs for all test are given in Turley (1992, 1993a, 1993b, and 1993c).

3.1.4 Test End Points and Data Analyses

The end points for the 7-d survival and reproduction tests with the cladoceran were survival and young production. The end points for the fathead minnow 7-d survival and growth tests were survival and growth expressed as dry weight. The statistical analyses of the 7-d short-term chronic data were conducted as follows. The raw daphnid survival data sets were analyzed by Fisher's Exact test. Arc-sine square root transformations were made on the fathead minnow raw survival data before further data analyses were performed. With the exception of the daphnid survival data, all other data (both transformed and raw data) were then subjected to a chi-square test of normality and Bartlett's test for homogeneity of variance.

When the data sets met the assumptions of normality and homogeneity of variance, a parametric statistic was used. Dunnett's test was used when the number of replicates was constant among treatments. A t-test with Bonferroni adjustment of error rate was performed when the number of replicates was not constant among treatments. When a data set failed to meet the assumptions of normality or homogeneity of variance, the nonparametric Steel's Many-One Rank test was performed. The statistical tests were performed using Toxstat (Gulley et al., 1989). A minimum probability level of 0.05 was used for all tests.

The test end point for the 48-h acute toxicity tests with both the cladoceran and fathead minnow was mortality. When mortality occurs, LC50s are determined by the moving average angle method as recommended by EPA for measuring the acute toxicity of effluents to freshwater and marine organisms (Weber, 1991). The moving average angle LC50s and their 95% confidence limits are determined by an EPA statistical program (Stephan, 1978). The reference toxicant LC50s were also determined by the moving average angle method. All LC50 values and their 95% confidence limits are reported as percent effluent by volume for the effluent tests and as mg/L as potassium chloride (nominal concentrations) for the KCl reference tests.

3.2 Effluent Chemical Analyses

A 24-h composite effluent sample was taken on October 26, 1992 for enumeration of general water quality and to quantify any priority pollutants present in the effluent. In addition to the priority pollutant analyses, MDE required that a library identification search be conducted on the 10 "highest" volatile and semi-volatile organics peaks present in the sample. The composite sample was taken as discussed in Section 3.1.1, dispensed into appropriate subsample containers, and delivered on ice the day of collection to Biospherics Inc. (Beltsville, MD) for analysis. The 24-h composite sample log and chain of custody log for the samples are given in Turley (1992).

Fourteen heavy metals had to be retested because Biospherics Inc. did not conduct the analyses at the method detection level (MDL) required by the Maryland Department of the Environment (MDE) Water Management Administration Toxic Substance Analytical Protocol (MDE, 1991). Biospherics Inc. reanalyzed 13 of the 14 metals, within a 6-month holding period, using the effluent sample taken October 26, 1992 which was archived (frozen) at Biospherics Inc. Hexavalent chromium was retested from an aliquot taken from the 24-h biomonitoring composite effluent sample collected on April 5, 1993. The 24-h composite sample log and chain of custody log for the sample are given in Turley (1993b).

Three metals had to subsequently be retested a third time because Biospherics Inc. still did not meet the MDL required by the Maryland Department of the Environment (MDE, 1991). Arsenic, nickel, and selenium were retested by Gascoyne Laboratories, Inc. (Baltimore, MD) from an aliquot taken from the 24-h biomonitoring composite effluent sample collected on July 12, 1993. The 24-h composite sample log and chain of custody log for the sample are given in Turley (1993c).

SECTION 4

RESULTS AND DISCUSSION

4.1 Biomonitoring Studies

The results of the 7-d chronic and 48-h acute tests, which include the water quality during each test, raw data, and statistical analyses of all end points, are summarized in the following Appendices. The first quarter 7-d chronic tests for the cladoceran and fathead minnow are given in Appendices 1 and 2, respectively. The second quarter 7-d chronic tests for the cladoceran and fathead minnow are summarized in Appendices 3 and 4. The third and fourth quarter 48-h acute test data for both species are presented in Appendices 5 and 6, and Appendices 7 and 8, respectively.

4.1.1 Chronic Tests

The results of the first quarter 7-d chronic cladoceran test are given in Appendix 1. The water quality during the test is summarized in Appendix 1, Table A1-1. Ft. Detrick WWTP effluent did not affect the survival of the cladocerans after 7 d of exposure to the effluent (Appendix 1; Table A1-2). The number of young produced per brood, total number of young, and mean number of young per brood are given in Appendix 1, Table A1-3. The statistical analyses of total neonate production, which are summarized in Appendix 1, Table A1-4, show that the effluent did not affect production during the 7 d exposure.

Fathead minnow larval survival was not affected by 7 d of exposure to Ft. Detrick WWTP effluent during the first quarter test (Appendix 2; Tables A2-2 and A2-3). The effluent did not cause a decrease in fathead minnow larval growth (Appendix 2; Table A2-4). Significant increases ($\alpha = 0.05$) in growth, however, occurred at 18 and 100 percent effluent by volume (Appendix 2; Tables A2-5 and A2-6). The statistically significant ($\alpha = 0.05$) increases in growth at 18 and 100 percent effluent by volume relative to the controls appear to be random events which can occur in 5% of the cases when using hypothesis testing at the 0.05 significance level.

As was the case in the first quarter, cladoceran survival was not affected by 7 d of exposure to effluent during the second quarter test (Appendix 3; Table A3-2). Similarly, total neonate production was not affected during the 7 d exposure (Appendix 3; Tables A3-3 and A3-4).

Ft. Detrick WWTP effluent caused a statistically significant ($\alpha = 0.05$) reduction in survival of fathead minnow larvae after 7 d of exposure in the 56 percent effluent by volume concentration

only (Appendix 4; Tables A4-2, A4-3, and A4-4). Since no statistically significant mortality occurred in any other concentrations including 100% effluent, the reduction in survival at 56 percent effluent by volume is most likely due to statistical chance. The effluent did not cause a decrease in fathead minnow larval growth (Appendix 4; Tables A4-5 and A4-6).

4.1.2 Acute Tests

The effluent was not acutely toxic to cladocerans after 48 h of exposure in the third quarter test (Appendix 5; Table A5-2). Although three out of 20 organisms died in 100 percent effluent, an acute toxicity 48-h LC50 could not be calculated. The effluent did not cause any mortality in the third quarter to the fathead minnow (Appendix 6; Tables A6-2).

Ft. Detrick WWTP effluent was not acutely toxic to the cladoceran after 48 h of exposure in the fourth quarter test (Appendix 7; Table A7-2). Only one out of 20 organisms died in 100% effluent; thus, an LC50 could not be calculated. As was the case in the third quarter test, the effluent did not cause any mortality to the fathead minnow in the fourth quarter test (Appendix 8; Table A8-2).

4.1.3 Reference Toxicant Tests

The 48-h LC50s and 95% confidence limits of the KCl reference toxicant tests with neonate cladocerans (<24 h old) and juvenile fathead minnow (<30 d old) are given in Table 5. The reference toxicant quality assurance data for the cladoceran and fathead minnow fell within ± 2 S.D. of the mean for the test period. Thus, the overall precision and repeatability of the bioassays were good.

4.2 Effluent Chemical Analyses

The raw data and QA/QC criteria for the chemical analyses of the Ft. Detrick WWTP effluent are given in Appendices 9, 10, and 11. The quantitative limit, analytical method, CAS number, date sample was collected, date sample was analyzed, and concentration of each chemical when at or above the quantitative limit are given in the Appendices. Appendix 9 contains the data for the original composite sample taken concurrently with the first biomonitoring composite sample on October 26, 1992. The 14 heavy metals that had to be retested because Biospherics Inc. failed to meet the Maryland Department of the Environment's method detection levels are given in Appendix 10. Appendix 11 contains the Gascoyne Laboratories, Inc. analyses of arsenic, nickel, and selenium that had to be retested a third time because Biospherics Inc. failed to meet the MDLs required by the Maryland Department of the Environment.

A summary of those chemicals whose concentrations were at or above the quantitative limits given in Appendices 9 - 11 is given in Table 6. Four (Cu, Pb, Ni, and Zn) of 12 heavy metal priority pollutants (Section 307 toxic pollutants) were found in the effluent. Two volatile organics (bromodichloromethane and dibromochloromethane) were found. No semi-volatile organics, pesticides/PCBs or herbicides were detected. The library search for the identification of additional semi-volatile organics yielded 12 peaks with estimated total concentrations of 102 $\mu\text{g/L}$. Probabilities of matches with compounds in the ion chromatogram database library ranged from 15 to 70% (Appendix 9), which in all cases were lower than the normal applicable threshold for declaring an identification of the peak. Further testing would be required for conclusive identification of the observed compound peaks. The library search for volatile organics yielded no information of significance (Appendix 9).

SECTION 5

CONCLUSIONS

The Ft. Detrick WWTP effluent was not toxic to the cladoceran or fathead minnow when tested in both chronic and acute bioassays over a one-year period. Two quarterly 7-d chronic tests with the cladoceran showed that the effluent did not cause appreciable mortality or reduction in neonate production. Likewise, no mortality or statistically significant ($\alpha = 0.05$) reduction in growth occurred to fathead minnow during two quarterly 7-d tests. No acute 48-h LC50s were obtained for the cladoceran or fathead minnow during two quarterly tests.

One priority pollutant analysis of the effluent showed that four (Cu, Pb, Ni, and Zn) of 12 heavy metal priority pollutants (Section 307 toxic pollutants) were present in the effluent. The concentrations of the four heavy metals, with the exception of lead for chronic exposure, were below the EPA numerical water quality criteria for acute and chronic toxicity of the metals to freshwater organisms (U.S. EPA, 1986). The EPA freshwater chronic criterion value for lead is 3.2 $\mu\text{g/L}$; 6 $\mu\text{g/L}$ were found in the effluent sample. Two volatile organics (bromodichloromethane and dibromochloromethane) were also found. Both halomethanes are well below the EPA numerical water quality criterion for acute toxicity to freshwater organisms; no criterion is available for chronic exposure to halomethanes (U.S. EPA, 1986). No semi-volatile organics, pesticides/PCBs or herbicides were detected.

SECTION 6

LITERATURE CITED

- APHA et al. (American Public Health Association, American Water Works Association, and Water Pollution Control Federation). 1992. Standard methods for the examination of water and wastewater, 18th ed. American Public Health Association, Washington, DC.
- Gulley, D.H., A.M. Boelter, and H.L. Bergman. 1989. Toxstat release 3.2. University of Wyoming, Laramie, WY.
- Hahn, T.E. 1992. Personal communication. Operations and Maintenance Division, Ft. Detrick, Frederick, MD.
- MDE (Maryland Department of the Environment). 1991. Reporting requirements for priority pollutant analytical data, Sept. 30, 1991. Water Management Administration, Maryland Department of the Environment, Baltimore, MD.
- Peltier, W.H. and C.I. Weber. 1985. Methods for measuring the acute toxicity of effluents to freshwater and marine organisms, 3rd ed. EPA/600/4-85/013. U.S. Environmental Protection Agency, Environmental Monitoring and Support Laboratory - Cincinnati, OH.
- Stephen, C.E. 1978. EPA statistics program, version 1.4. U.S. Environmental Protection Agency, Environmental Research Laboratory - Duluth, Duluth, MN.
- Turley, S.D. 1992. Fort Detrick Wastewater Treatment Plant biomonitoring study. WWTP Task Report No. 1. University of Maryland Wye Research and Education Center, Queenstown, MD. DAMD17-92-C-2066.
- Turley, S.D. 1993a. Fort Detrick Wastewater Treatment Plant biomonitoring study. WWTP Task Report No. 2. University of Maryland Wye Research and Education Center, Queenstown, MD. DAMD17-92-C-2066.
- Turley, S.D. 1993b. Fort Detrick Wastewater Treatment Plant biomonitoring study. WWTP Task Report No. 3. University of Maryland Wye Research and Education Center, Queenstown, MD. DAMD17-92-C-2066.
- Turley, S.D. 1993c. Fort Detrick Wastewater Treatment Plant biomonitoring study. WWTP Task Report No. 4. University of Maryland Wye Research and Education Center, Queenstown, MD. DAMD17-92-C-2066.

- U.S. EPA. 1986. Quality criteria for water 1986. U.S. Environmental Protection Agency, Office of Water Regulations and Standards, Washington, DC.
- Weber, C.I. (ed.). 1991. Methods for measuring the acute toxicity of effluents and receiving waters to freshwater and marine organisms, 4th ed. EPA/600/4-90/027. U.S. Environmental Protection Agency, Environmental Monitoring and Support Laboratory - Cincinnati, OH.
- Weber, C.I., W.H. Peltier, T.J. Norberg-King, W.B. Horning, II, F.A. Kessler, J.R. Menkedick, T.W. Neiheisel, P.A. Lewis, D.J. Klemm, Q.H. Pickering, E.L. Robinson, J.M. Lazorchak, L.J. Wymer, and R.W. Freyberg. 1989. Short-term methods for estimating the chronic toxicity of effluents and receiving waters to freshwater organisms, 2nd ed. EPA/600/4-89/001. U.S. Environmental Protection Agency, Environmental Monitoring and Support Laboratory - Cincinnati, OH.
- Winner, R.W. 1989. Multigeneration life-span tests of the nutritional adequacy of several diets and culture waters for Ceriodaphnia dubia. Environ. Toxicol. Chem. 8:513-520.

TABLE 1. SUMMARY OF EPA TEST CONDITIONS AND TEST ACCEPTABILITY CRITERIA FOR THE CLADOCERAN 7-D CHRONIC TOXICITY SURVIVAL AND REPRODUCTION TEST

1. Test type:	Static; renewal every 24 h
2. Temperature:	25 ± 1°C
3. Light quality:	Ambient laboratory illumination
4. Light intensity:	50-100 foot candles
5. Photoperiod:	16 h light:8 h darkness
6. Test chamber size:	30 mL
7. Test solution volume:	15 mL
8. Renewal of test solutions:	Daily
9. Age of test organisms:	<24 h; all released within a an 8-h period
10. No. neonates per test chamber:	1
11. No. replicate test chambers/concentration:	10
12. No. neonates per test concentration:	10
13. Feeding regime:	Feed 0.1 mL each of YCT and algal suspension per test chamber daily
14. Aeration:	None
15. Dilution water:	20% Perrier; 90% RO Water Reverse osmosis
16. Effluent concentrations:	Minimum of 5 and a control
17. Dilution factor:	≥0.5 dilution series

TABLE 1. (CONTINUED)

18. Test duration:	Until 60% of control females have three broods (may require more or less than 7 days)
19. Endpoints:	Survival and reproduction
20. Sampling and sample holding requirements:	Samples will be collected daily and used within 36 h of the time they are removed from the sampling device.
21. Sample volume required:	1 L
22. Test acceptability:	80% or greater survival and an average of 15 or more young/surviving female in the control solutions. At least 60% of surviving females in controls should have produced their third brood

TABLE 2. SUMMARY OF EPA TEST CONDITIONS AND TEST ACCEPTABILITY CRITERIA FOR THE FATHEAD MINNOW 7-D CHRONIC TOXICITY LARVAL SURVIVAL AND GROWTH TEST

1. Test type:	Static; renewal every 24 h
2. Temperature:	25 ± 1°C
3. Light Quality:	Ambient laboratory illumination
4. Light intensity:	50-100 foot candles
5. Photoperiod:	16 h light:8 h darkness
6. Test chamber size:	500 mL
7. Test solution volume:	250 mL/replicate
8. Renewal of test concentrations:	Daily
9. Age of test organisms:	Newly hatched larvae less than 24 h old
10. No. larvae per test chamber:	15 (minimum of 10)
11. No. replicate chambers per concentration:	4 (minimum of 3)
12. No. larvae per concentration:	60 (minimum of 30)
13. Feeding regime:	Feed 0.1 mL newly hatched (<24-h old) brine shrimp nauplii three times daily at 4-h intervals or, as a minimum, 0.15 mL twice daily, 6 h between feedings (at the beginning of the work day prior to renewal, and at the end of the work day following renewal). Sufficient nauplii are added to provide an excess. Larvae are not fed during the final 12 h of the test.
14. Test chamber cleaning:	Siphon daily, immediately before test solution renewal

TABLE 2. (CONTINUED)

15. Aeration:	None, unless DO concentration falls below 40% saturation. Rate should not exceed 100 bubbles/min
16. Dilution water:	Wye Research & Education Center nonchlorinated tap water
17. Effluent concentrations:	Minimum of 5 and a control
18. Dilution factor:	≥0.5 dilution series
19. Test duration:	7 days
20. Sampling and sample holding requirements:	Samples will be collected daily and used within 36 h of the time they are removed from the sampling device.
21. Sample volume required:	2.5 L/day
22. Endpoints:	Survival and growth (weight)
23. Test acceptability:	80% or greater survival in controls; average dry weight of surviving controls equals or exceeds 0.25 mg

TABLE 3. SUMMARY OF EPA TEST CONDITIONS AND TEST ACCEPTABILITY CRITERIA FOR THE CLADOCERAN 48-H ACUTE TOXICITY TESTS

1. Test type:	Static; 24-h renewal
2. Test duration:	48 h
3. Temperature:	25 ± 1°C
4. Light quality:	Ambient laboratory illumination
5. Light intensity:	50-100 foot candles
6. Photoperiod:	16 h light:8 h darkness
7. Test chamber size:	30 mL (minimum)
8. Test solution volume:	15 mL (minimum)
9. Renewal of test solutions:	24 h
10. Age of test organisms:	<24 h old
11. No. organisms per test chamber:	Minimum of 5
12. No. replicate chambers per concentration:	Minimum of 4
13. No. organisms per concentration:	Minimum of 20
14. Feeding regime:	Feed YCT and <u>Selenastrum</u> while holding prior to the test; newly released young should have food available a minimum of 2 h prior to use in a test; organisms are not normally fed during a 48 h test
15. Test chamber cleaning:	Cleaning not required
16. Test chamber aeration:	None
17. Dilution water:	20% Perrier; 80% RO Water Reverse osmosis

TABLE 3. (CONTINUED)

18. Effluent concentrations:	Minimum of 5 and a control
19. Dilution series:	≥ 0.5 dilution series
20. Endpoint:	Mortality (48-h LC50)
21. Sampling and sample holding requirements:	Composite samples will be used within 36 h of completion of the sampling period
22. Sample volume required:	1 L
23. Test acceptability criterion:	90% or greater survival in controls

TABLE 4. SUMMARY OF EPA TEST CONDITIONS AND TEST ACCEPTABILITY CRITERIA FOR THE FATHEAD MINNOW 48-H ACUTE TOXICITY TESTS

1. Test type:	Static; 24-h renewal
2. Test duration:	48 h
3. Temperature:	25 ± 1°C
4. Light quality:	Ambient laboratory illumination
5. Light intensity:	50-100 foot candles
6. Photoperiod:	16 h light:8 h darkness
7. Test chamber size:	250 mL (minimum)
8. Test solution volume:	200 mL (minimum)
9. Renewal of test solutions:	24 h
10. Age of test organisms:	1-14 days; 24-h range in age
11. No. organisms per test chamber:	Minimum of 10
12. No. replicate chambers per concentration:	Minimum of 2
13. No. organisms per concentration:	Minimum of 20
14. Feeding regime:	<u>Artemia</u> nauplii are made available while holding prior to the test; organisms are not normally fed during a 48 h test
15. Test chamber cleaning:	Cleaning not required
16. Test chamber aeration:	None, unless DO concentration falls below 4.0 mg/L; rate should not exceed 100 bubbles/min
17. Dilution water:	Wye Research & Education Center nonchlorinated tap water

TABLE 4. (CONTINUED)

18. Effluent concentrations:	Minimum of 5 and a control
19. Dilution series:	≥ 0.5 dilution series
20. Endpoint:	Mortality (48-h LC50)
21. Sampling and sample holding requirements:	Composite samples will be used within 36 h of completion of the sampling period
22. Sample volume required:	2 L
23. Test acceptability criterion:	90% or greater survival in controls

TABLE 5. SUMMARY OF THE 48-H LC50 VALUES AND ASSOCIATED 95% CONFIDENCE LIMITS OF THE CLADOCERAN (<24 H OLD) AND FATHEAD MINNOW (<30 D OLD) EXPOSED TO THE REFERENCE TOXICANT POTASium CHLORIDE

Date Bioassay Initiated	Cladoceran 48-h LC50 (95% CL) (mg/L)	Fathead Minnow 48-h LC50 (95% CL) (mg/L)
10/07/92	447 (1 - 499.4)	1336 (1203.8 - 1497.8)
01/04/93	462 (1 - 518.5)	1387 (1249.0 - 1560.6)
03/29/93	462 (1 - 518.5)	1291 (1162.6 - 1442.8)
07/01/93	441 (1 - 500.8)	1316 (1185.6 - 1473.3)

TABLE 6. SUMMARY OF ALL QUANTIFIABLE PARAMETERS IN THE FT. DETRICK WWTP EFFLUENT^a

Parameter	Concentration
<u>General Water Chemistry (mg/L)</u>	
Alkalinity (as CaCO ₃)	76
Ammonia (as N)	0.037
Chloride	110
Conductivity (umho/cm)	820
Fecal coliform (MPN/100mL)	4
Fluoride	0.90
Hardness (as CaCO ₃)	153
Nitrite-N	5.67
Nitrate-N	^b
Phosphorous (as P)	1.56
Sulfide	13.2
Total organic carbon	20
<u>Metals (μg/L)</u>	
Aluminum	45.0
Boron	160
Calcium	46100
Copper	11.9
Iron	120
Lead	6.0
Magnesium	9310
Nickel	8
Potassium	7340
Sodium	58500
Zinc	37.5
<u>Volatile Organics (μg/L)</u>	
Bromodichloromethane	10
Dibromochloromethane	6
<u>Semi-Volatile Organics (μg/L)</u>	
All semi-volatile organics were below quantification limits	
<u>Herbicides and Pesticides/PCBs</u>	
All herbicides and pesticides/PCBs were below quantification limits	

TABLE 6. CONTINUED

- The quantification limits, analytical methods, CAS numbers, etc. for all chemicals including those in Table 6 are given in Appendices 9 - 11 (see text for details).
- ^b Vendor lost sample.

APPENDIX 1

CLADOCERAN 7-D SURVIVAL AND REPRODUCTION TEST CONDUCTED ON FT. DETRICK WWTP EFFLUENT (FIRST QUARTER TEST)

Name of Test:	CERIODAPHNIA 7-DAY CHRONIC
Test Method:	EPA/600/4-89/001
Type of Test:	Static renewal (every 24 h)
Date:	October 26 - November 2, 1992
Investigator:	S. D. Turley
Laboratory:	UMD/WREC
Effluent:	
Source:	Ft. Detrick WWTP
Chemical Characteristics:	Appendix 9
Dilution Water:	
Source:	20% Perrier; 80% RO Water
Chemical Characteristics:	Table A1-1
Test Organism:	
Scientific Name:	<u>Ceriodaphnia dubia</u>
Wet Weight:	n/a
Length:	n/a
Age:	<24 h; all released within a 4-h period
Source:	UMD/WREC Culture
Experimental Chambers:	
Material:	30-mL glass beakers
Volume:	15 mL
No. Organisms Per Treatment:	10
Loading:	1 organism/beaker
Lighting:	Fluorescent; 50-100 foot candles
Metering System:	n/a

Flow Rate:	n/a
Aeration:	Prior to each renewal
Endpoints:	Mortality of adults; number of neonates produced in 3 broods
Bioassay Water Quality Data:	Table A1-1
Results:	

The effluent did not affect the survival of the cladocerans after 7 d of exposure (Table A1-2). Likewise, the effluent did not affect neonate production during the 7 d exposure (Tables A1-3 and A1-4).

TABLE A1-1. SUMMARY OF THE FIRST QUARTER FT. DETRICK WWTP
EFFLUENT BIOASSAY WATER QUALITY DATA FOR THE
CLADOCERAN 7-DAY TEST - DISSOLVED OXYGEN (MG/L)

	<u>Test Concentrations (Percent Effluent by Volume)</u>					
	0.0	10	18	32	56	100
<u>Day 0</u>						
0 H	7.9	8.0	7.8	8.0	7.8	8.2
<u>Day 1</u>						
0 H	8.2	7.8	7.8	7.7	8.0	8.4
24 H	7.2	7.3	7.3	7.4	7.0	7.3
<u>Day 2</u>						
0 H	8.0	8.0	8.1	8.0	8.0	8.4
24 H	7.5	7.6	7.5	7.1	7.4	7.5
<u>Day 3</u>						
0 H	8.2	8.1	8.0	8.1	7.9	8.1
24 H	7.5	7.5	7.4	7.3	7.1	7.3
<u>Day 4</u>						
0 H	8.3	8.2	8.3	8.4	8.5	9.1
24 H	7.5	7.5	7.5	7.5	7.6	7.8
<u>Day 5</u>						
0 H	8.5	8.4	8.3	8.3	8.3	8.7
24 H	7.4	7.3	7.2	7.4	7.5	7.6
<u>Day 6</u>						
0 H	8.3	8.2	8.2	8.3	8.2	8.5
24 H	7.3	7.3	7.1	7.3	7.4	7.5
<u>Day 7</u>						
24 H	7.2	7.3	7.1	7.2	7.3	7.4

TABLE A1-1. (CONTINUED) - pH

	<u>Test concentrations (Percent Effluent by Volume)</u>					
	0.0	10	18	32	56	100
<u>Day 0</u>						
0 H	7.48	7.55	7.54	7.49	7.43	7.21
<u>Day 1</u>						
0 H	6.71	7.13	7.14	7.19	7.12	6.98
24 H	7.03	7.28	7.37	7.43	7.49	7.58
<u>Day 2</u>						
0 H	7.07	7.18	7.19	7.27	7.29	7.20
24 H	7.30	7.41	7.49	7.58	7.64	7.70
<u>Day 3</u>						
0 H	6.63	6.97	7.07	7.12	7.14	7.09
24 H	7.15	7.23	7.32	7.42	7.50	7.58
<u>Day 4</u>						
0 H	6.80	6.94	7.02	7.03	7.04	6.91
24 H	7.12	7.25	7.34	7.45	7.52	7.60
<u>Day 5</u>						
0 H	6.84	7.00	7.03	7.05	7.07	6.99
24 H	7.16	7.27	7.29	7.37	7.41	7.50
<u>Day 6</u>						
0 H	6.91	7.04	7.07	7.08	7.09	7.00
24 H	7.19	7.23	7.31	7.39	7.46	7.52
<u>Day 7</u>						
24 H	7.14	7.20	7.27	7.34	7.40	7.46

TABLE A1-1. (CONTINUED) - CONDUCTIVITY (μ MHOS/CM)

	<u>Test Concentrations (Percent Effluent by Volume)</u>					
	0.0	10	18	32	56	100
<u>Day 0</u>						
0 H	180	215	250	300	400	500
<u>Day 1</u>						
0 H	170	210	210	270	330	470
24 H	210	240	280	320	340	500
<u>Day 2</u>						
0 H	220	225	255	240	370	485
24 H	225	240	280	340	445	700
<u>Day 3</u>						
0 H	210	220	250	305	415	475
24 H	225	245	280	340	430	480
<u>Day 4</u>						
0 H	175	220	250	310	405	650
24 H	195	240	275	340	410	470
<u>Day 5</u>						
0 H	180	210	240	300	410	590
24 H	190	230	290	350	420	490
<u>Day 6</u>						
0 H	170	200	250	310	420	600
24 H	200	220	300	340	410	510
<u>Day 7</u>						
24 H	190	210	290	320	400	500

TABLE A1-1. (CONTINUED) - ALKALINITY (MG/L AS CaCO_3)

	Test Concentrations (Percent Effluent by Volume)					
	0.0	10	18	32	56	100
<u>Day 0</u>						
0 H	68	60	60	58	55	55
<u>Day 1</u>						
0 H	50	50	58	55	50	45
24 H	55	65	65	70	60	55
<u>Day 2</u>						
0 H	55	55	60	60	65	60
24 H	60	50	55	70	70	65
<u>Day 3</u>						
0 H	60	50	55	70	65	65
24 H	65	45	60	75	75	70
<u>Day 4</u>						
0 H	55	60	60	60	60	65
24 H	60	55	60	65	70	65
<u>Day 5</u>						
0 H	55	65	60	65	60	60
24 H	65	55	65	65	65	60
<u>Day 6</u>						
0 H	55	60	65	60	60	55
24 H	60	60	70	65	65	60
<u>Day 7</u>						
24 H	65	60	65	65	70	65

TABLE A1-1. (CONTINUED) - HARDNESS (MG/L AS CaCO_3)

	<u>Test Concentrations (Percent Effluent by Volume)</u>					
	0.0	10	18	32	56	100
<u>Day 0</u>						
0 H	78	76	88	112	112	139
<u>Day 1</u>						
0 H	64	64	90	98	102	140
24 H	68	72	98	102	110	142
<u>Day 2</u>						
0 H	66	70	84	116	126	144
24 H	80	84	90	112	120	138
<u>Day 3</u>						
0 H	66	70	84	116	126	144
24 H	76	76	90	112	132	148
<u>Day 4</u>						
0 H	68	76	88	94	110	150
24 H	80	84	90	112	120	138
<u>Day 5</u>						
0 H	70	76	88	98	112	138
24 H	68	72	90	80	110	124
<u>Day 6</u>						
0 H	68	72	90	100	110	144
24 H	70	72	72	80	102	134
<u>Day 7</u>						
24 H	68	72	88	88	94	138

TABLE A1-1. (CONTINUED)- TEMPERATURE (°C)

	<u>Test Concentrations (Percent Effluent by Volume)</u>					
	0.0	10	18	32	56	100
<u>Day 0</u>						
0 H	25.1	25.0	25.0	25.0	24.9	24.9
<u>Day 1</u>						
0 H	24.9	24.9	24.9	24.8	24.9	24.9
<u>Day 2</u>						
0 H	25.1	25.1	25.1	25.0	25.0	25.0
<u>Day 3</u>						
0 H	25.1	25.1	25.0	25.0	25.0	24.9
<u>Day 4</u>						
0 H	25.1	25.1	25.1	25.1	25.0	25.0
<u>Day 5</u>						
0 H	25.1	25.1	25.0	25.0	25.0	24.9
<u>Day 6</u>						
0 H	25.0	25.0	25.0	25.0	25.0	25.0
<u>Day 7</u>						
24 H	25.1	25.1	25.1	25.0	25.0	25.0

TABLE A1-2. SURVIVAL OF CLADOCERANS AFTER 7 DAYS OF EXPOSURE TO FT. DETRICK WWTP EFFLUENT DURING THE FIRST QUARTER TEST

Concentration (% Effluent by Volume)	Number Tested	No. Alive at End of Test	Percent Alive
UMD/WREC Control	10	10	100
10	10	10	100
18	10	10	100
32	10	10	100
56	10	9	90
100	10	10	100

TABLE A1-3. NUMBER OF YOUNG PRODUCED PER BROOD, TOTAL NUMBER OF YOUNG, AND MEAN NUMBER OF YOUNG PER BROOD DURING THE FIRST QUARTER TEST

Concentration (% Effluent by Volume)	Rep	Brood No. 1	Brood No. 2	Brood No. 3	Total Young	Mean Young Per Brood
UMD/WREC Control	1	5	8	14	27	9.0
	2	5	7	13	25	8.3
	3	4	9	13	26	8.7
	4	4	8	13	25	8.3
	5	5	9	12	26	8.7
	6	5	8	12	25	8.3
	7	3	9	12	24	8.0
	8	5	8	12	25	8.3
	9	4	9	14	27	9.0
	10	4	9	12	25	8.3
10	1	4	8	16	28	9.3
	2	3	7	11	21	7.0
	3	5	7	12	24	8.0
	4	4	8	11	23	7.7
	5	4	7	11	22	7.3
	6	4	7	11	22	7.3
	7	4	7	12	23	7.7
	8	5	9	12	26	8.7
	9	4	11	13	28	9.3
	10	5	8	12	25	8.3
18	1	5	8	15	28	9.3
	2	4	6	12	22	7.3
	3	6	7	10	23	7.7
	4	4	0	14	18	6.0
	5	6	7	11	24	8.0
	6	4	7	12	23	7.7
	7	5	9	11	25	8.3
	8	3	8	12	23	7.7
	9	5	9	15	29	9.7
	10	4	7	15	26	8.7

TABLE A1-3. (CONTINUED)

Concentration (% Effluent by Volume)	Rep	Brood No. 1	Brood No. 2	Brood No. 3	Total Young	Mean Young Per Brood
32	1	3	6	12	21	7.0
	2	5	8	11	24	8.0
	3	6	12	14	32	10.7
	4	3	8	12	23	7.7
	5	4	7	15	26	8.7
	6	5	9	12	26	8.7
	7	6	9	13	28	9.3
	8	5	10	14	29	9.7
	9	5	9	14	28	9.3
	10	5	7	11	23	7.7
56	1	4	9	10	23	7.7
	2	5	7	10	22	7.3
	3	5	8	10	23	7.7
	4	4	8	14	26	8.7
	5	5	9	11	25	8.3
	6	3	7	14	24	8.0
	7	6	9	12	27	9.0
	8	4	7	13	24	8.0
	9	4	DEAD			
	10	5	6	13	24	8.0
100	1	6	6	11	23	7.7
	2	4	6	11	21	7.0
	3	4	10	11	25	8.3
	4	5	6	13	24	8.0
	5	4	8	11	23	7.7
	6	5	9	11	25	8.3
	7	4	7	12	23	7.7
	8	MALE				
	9	5	8	13	26	8.7
	10	6	8	14	28	9.3

TABLE A1-4. STATISTICAL ANALYSIS OF TOTAL NEONATE PRODUCTION
DURING THE FIRST QUARTER TEST

Data Transformation:

None

Chi-Square Test for Normality:

Calculate test statistic:	9.45
Alpha value:	0.01
Critical value:	13.27
Conclusion:	Fail to reject the null hypothesis that the data are normally distributed

Bartlett's Test for Homogeneity of Variances:

Calculated test statistic:	14.49
Alpha value:	0.01
Critical value:	15.09
Conclusion:	Fail to reject the null hypothesis that the variances are homogenous

ANOVA:

Calculated test statistic:	1.10
Alpha value:	0.05
Critical value:	2.45
Conclusion:	Fail to reject the null hypothesis that all groups are equal

APPENDIX 2

FATHEAD MINNOW 7-D SURVIVAL AND GROWTH TEST CONDUCTED ON FT. DETRICK WWTP EFFLUENT (FIRST QUARTER TEST)

Name of Test:	FATHEAD 7-D CHRONIC
Test Method:	EPA/600/4-89/001
Type of Test:	Static renewal (every 24 h)
Date:	October 26 - November 2, 1992
Investigators:	S. D. Turley
Laboratory:	UMD/WREC
Effluent:	
Source:	Ft. Detrick WWTP
Chemical Characteristics:	Appendix 9
Dilution Water:	
Source:	UMD/WREC nonchlorinated tap water
Chemical Characteristics:	Table A2-1
Test Organism:	
Scientific Name:	<u>Pimephales promelas</u>
Age:	Newly hatched larvae <24 h old at start of test
Source:	UMD/WREC culture
Experimental Chambers:	
Material:	500 mL glass beakers
Volume:	250 mL
No. Organisms Per Replicate:	10
No. Organisms Per Treatment:	40
Loading:	<0.5 g/L
Lighting:	Fluorescent; 50-100 foot candles
Metering System:	n/a

Flow Rate:	n/a
Aeration:	None
Endpoints:	Mortality; growth
Bioassay Water Quality Data:	See Table A2-1
Results:	

The effluent did not affect the survival of fathead minnow larvae after 7 d of exposure (Tables A2-2 and A2-3). The effluent did not cause a decrease in fathead minnow larval growth. Significant increases ($\alpha = 0.05$) in growth, however, occurred at 18 and 100 percent effluent by volume (Table A2-4). The statistical analyses of the growth data are summarized in Tables A2-5 and A2-6.

TABLE A2-1. SUMMARY OF THE FIRST QUARTER FT. DETRICK WWTP
EFFLUENT BIOASSAY WATER QUALITY DATA FOR THE FATHEAD
MINNOW 7-DAY TEST - DISSOLVED OXYGEN (MG/L)

	<u>Test Concentrations (Percent Effluent by Volume)</u>					
	0.0	10	18	32	56	100
<u>Day 0</u>						
0 H	8.4	8.3	7.9	7.8	8.0	8.3
<u>Day 1</u>						
0 H	8.1	8.3	8.2	8.0	8.4	8.5
24 H	6.2	5.7	5.1	5.2	5.1	5.0
<u>Day 2</u>						
0 H	8.0	7.8	7.9	7.9	8.1	7.5
24 H	6.5	6.2	6.1	5.7	5.2	5.2
<u>Day 3</u>						
0 H	8.0	8.0	7.8	7.9	8.0	8.1
24 H	6.5	6.3	6.6	6.3	6.0	6.2
<u>Day 4</u>						
0 H	8.3	8.3	8.3	8.5	8.5	8.5
24 H	6.7	6.9	6.9	7.0	6.4	6.5
<u>Day 5</u>						
0 H	8.4	8.2	8.2	8.1	8.1	8.0
24 H	6.2	6.9	6.9	6.7	6.7	6.5
<u>Day 6</u>						
0 H	8.3	8.3	8.1	8.0	8.0	8.2
24 H	6.6	6.7	7.0	6.8	6.8	6.6
<u>Day 7</u>						
24 H	6.9	6.5	6.7	6.7	6.8	6.7

TABLE A2-1. (CONTINUED) - pH

	<u>Test concentrations (Percent Effluent by Volume)</u>					
	0.0	10	18	32	56	100
<u>Day 0</u>						
0 H	6.76	7.36	7.39	7.42	7.39	7.24
<u>Day 1</u>						
0 H	6.72	6.99	7.13	7.14	7.13	7.20
24 H	7.05	6.97	6.95	6.89	6.86	7.22
<u>Day 2</u>						
0 H	7.01	7.06	7.15	7.20	7.20	7.11
24 H	6.58	7.18	7.10	7.06	7.06	7.09
<u>Day 3</u>						
0 H	6.72	7.01	7.02	7.11	7.12	7.10
24 H	7.17	7.09	7.10	7.10	7.14	7.25
<u>Day 4</u>						
0 H	6.82	6.96	7.04	7.05	7.06	6.93
24 H	7.14	7.23	7.36	7.41	7.50	7.62
<u>Day 5</u>						
0 H	6.91	6.98	7.06	7.08	7.09	6.96
24 H	7.04	7.13	7.26	7.30	7.40	7.48
<u>Day 6</u>						
0 H	6.90	7.10	7.07	7.09	7.12	6.99
24 H	7.01	7.10	7.23	7.24	7.38	7.56
<u>Day 7</u>						
24 H	7.03	7.11	7.19	7.26	7.35	7.49

TABLE A2-1. (CONTINUED) - CONDUCTIVITY (μ MHOS/CM)

	Test Concentrations (Percent Effluent by Volume)					
	0.0	10	18	32	56	100
<u>Day 0</u>						
0 H	165	215	255	305	405	490
<u>Day 1</u>						
0 H	195	210	225	295	370	620
24 H	215	235	265	320	415	650
<u>Day 2</u>						
0 H	185	215	250	300	420	600
24 H	210	230	260	320	410	700
<u>Day 3</u>						
0 H	200	220	270	330	370	500
24 H	195	230	270	340	450	550
<u>Day 4</u>						
0 H	175	220	280	310	400	600
24 H	195	240	290	340	410	470
<u>Day 5</u>						
0 H	195	210	270	300	390	580
24 H	200	220	300	330	420	490
<u>Day 6</u>						
0 H	190	220	290	310	410	600
24 H	190	230	320	340	430	510
<u>Day 7</u>						
24 H	200	220	300	330	410	520

TABLE A2-1. (CONTINUED) - ALKALINITY (MG/L AS CaCO_3)

	<u>Test Concentrations (Percent Effluent by Volume)</u>					
	0.0	10	18	32	56	100
<u>Day 0</u>						
0 H	63	58	60	55	53	50
<u>Day 1</u>						
0 H	60	60	70	75	65	60
24 H	75	70	85	90	75	70
<u>Day 2</u>						
0 H	50	50	60	70	70	65
24 H	65	55	50	75	65	65
<u>Day 3</u>						
0 H	65	70	70	75	70	60
24 H	60	65	60	70	70	55
<u>Day 4</u>						
0 H	55	60	65	65	65	60
24 H	50	55	60	60	60	70
<u>Day 5</u>						
0 H	60	60	65	65	70	65
24 H	55	60	60	60	65	60
<u>Day 6</u>						
0 H	55	65	60	65	65	60
24 H	60	60	60	60	65	55
<u>Day 7</u>						
24 H	60	60	65	60	65	60

TABLE A2-1. (CONTINUED) - HARDNESS (MG/L AS CaCO_3)

	Test Concentrations (Percent Effluent by Volume)					
	0.0	10	18	32	56	100
<u>Day 0</u>						
0 H	68	84	88	102	116	134
<u>Day 1</u>						
0 H	66	64	88	92	104	160
24 H	70	68	96	110	112	158
<u>Day 2</u>						
0 H	96	84	80	88	104	136
24 H	70	80	88	92	108	148
<u>Day 3</u>						
0 H	64	80	90	96	114	148
24 H	70	84	94	104	118	140
<u>Day 4</u>						
0 H	66	70	80	92	106	140
24 H	66	76	76	76	72	124
<u>Day 5</u>						
0 H	68	64	88	96	118	136
24 H	64	70	80	92	108	124
<u>Day 6</u>						
0 H	72	70	94	92	114	144
24 H	64	72	80	88	104	130
<u>Day 7</u>						
24 H	72	76	88	96	108	136

TABLE A2-1. (CONTINUED)- TEMPERATURE (°C)

	<u>Test Concentrations (Percent Effluent by Volume)</u>					
	0.0	10	18	32	56	100
<u>Day 0</u>						
0 H	25.0	25.0	25.0	25.1	25.0	25.0
<u>Day 1</u>						
0 H	25.0	25.1	25.1	25.1	25.1	25.1
<u>Day 2</u>						
0 H	25.1	25.1	25.1	25.0	25.0	25.0
<u>Day 3</u>						
0 H	25.0	25.0	25.0	25.0	25.0	25.0
<u>Day 4</u>						
0 H	25.1	25.1	25.1	25.1	25.0	25.0
<u>Day 5</u>						
0 H	25.0	25.0	25.0	25.0	25.0	25.0
<u>Day 6</u>						
0 H	25.1	25.1	25.0	25.0	25.0	24.9
<u>Day 7</u>						
24 H	25.0	25.0	25.0	25.0	25.0	25.0

TABLE A2-2. SURVIVAL OF FATHEAD MINNOW LARVAE AFTER 7 DAYS OF EXPOSURE TO FT. DETRICK WWTP EFFLUENT DURING THE FIRST QUARTER TEST

Concentration (% Effluent by Volume)	Rep	Number Tested	No. Alive at End of Test	Percent Alive
UMD/WREC Control	1	10	10	100
	2	10	9	90
	3	10	9	90
	4	10	10	100
10	1	10	9	90
	2	10	10	100
	3	10	8	80
	4	10	9	90
18	1	10	8	80
	2	10	10	100
	3	10	9	90
	4	10	9	90
32	1	10	9	90
	2	10	9	90
	3	10	9	90
	4	10	9	90
56	1	10	7	70
	2	10	10	100
	3	10	8	80
	4	10	9	90
100	1	10	10	100
	2	10	9	90
	3	10	7	70
	4	10	7	70

TABLE A2-3. STATISTICAL ANALYSIS OF LARVAL FATHEAD MINNOW
SURVIVAL DURING THE FIRST QUARTER TEST

Data Transformation:

Arc-sine square-root transformation

Chi-Square Test for Normality:

Calculated test statistic:	3.78
Alpha value:	0.01
Critical value:	13.28
Conclusion:	Fail to reject the null hypothesis that the data are normally distributed

Bartlett's Test for Homogeneity of Variances:

Conclusion:	Data failed to meet the homogeneity of variance assumption
-------------	--

Steel's Many-One Ranked Test:

Rank sum statistics:	14.00-17.00
Alpha value:	0.05
Critical value:	10.00
Conclusion:	Fail to reject the null hypothesis that all groups are equal

TABLE A2-4. GROWTH OF FATHEAD MINNOW LARVAE AFTER 7 DAYS OF EXPOSURE TO FT. DETRICK WWTP EFFLUENT DURING THE FIRST QUARTER TEST

Concentration (% Effluent by Volume)	Rep	Dry Weight (mg)	Mean Dry Weight (mg)
UMD/WREC Control	1	0.41	
	2	0.40	
	3	0.44	
	4	0.46	0.43
10	1	0.46	
	2	0.50	
	3	0.45	
	4	0.47	0.47
18	1	0.60	
	2	0.53	
	3	0.45	
	4	0.47	0.53
32	1	0.46	
	2	0.46	
	3	0.44	
	4	0.48	0.46
56	1	0.39	
	2	0.51	
	3	0.43	
	4	0.39	0.43
100	1	0.54	
	2	0.49	
	3	0.46	
	4	0.60	0.52

TABLE A2-5. STATISTICAL ANALYSIS OF LARVAL FATHEAD MINNOW GROWTH
DURING THE FIRST QUARTER TEST

Data Transformation:

None

Chi-Square Test for Normality:

Calculate test statistic:	4.98
Alpha value:	0.01
Critical value:	13.28
Conclusion:	Fail to reject the null hypothesis that the data are normally distributed

Bartlett's Test for Homogeneity of Variances:

Calculated test statistic:	7.09
Alpha value:	0.01
Critical value:	15.09
Conclusion:	Fail to reject the null hypothesis that the variances are homogenous

ANOVA:

Calculated test statistic:	See Table A2-6
Alpha value:	0.05
Critical value:	2.77
Conclusion:	Reject the null hypothesis that all groups are equal

TABLE A2-6. RESULTS OF DUNNETT'S TEST ON MEAN FATHEAD MINNOW
LARVAE GROWTH AFTER 7 DAYS OF EXPOSURE TO FT.
DETRICK WWTP EFFLUENT DURING THE FIRST QUARTER TEST

Concentration (% Effluent by volume)	No. of Reps	Mean Dry Weight (mg)	T Statistic	Significance
UMD/WREC Diluent Water	4	0.43		
10	4	0.47	1.34	
18	4	0.53	3.08	*
32	4	0.46	1.03	
56	4	0.43	0.08	
100	4	0.52	3.00	*

* Significantly different at alpha = 0.05 (Dunnett critical
value = 2.41).

APPENDIX 3

CLADOCERAN 7-D SURVIVAL AND REPRODUCTION TEST CONDUCTED ON FT. DETRICK WWTP EFFLUENT (SECOND QUARTER TEST)

Name of Test:	CERIODAPHNIA 7-DAY CHRONIC
Test Method:	EPA/600/4-89/001
Type of Test:	Static renewal (every 24 h)
Date:	January 11 - January 18, 1993
Investigator:	S. D. Turley
Laboratory:	UMD/WREC
Effluent:	
Source:	Ft. Detrick WWTP
Chemical Characteristics:	Appendix 9
Dilution Water:	
Source:	20% Perrier; 80% RO Water
Chemical Characteristics:	Table A3-1
Test Organism:	
Scientific Name:	<u>Ceriodaphnia dubia</u>
Wet Weight:	n/a
Length:	n/a
Age:	<24 h; all released within a 4-h period
Source:	UMD/WREC Culture
Experimental Chambers:	
Material:	30-mL glass beakers
Volume:	15 mL
No. Organisms Per Treatment:	10
Loading:	1 organism/beaker
Lighting:	Fluorescent; 50-100 foot candles
Metering System:	n/a

Flow Rate: n/a

Aeration: Prior to each renewal

Endpoints: Mortality of adults; number of neonates produced in 3 broods

Bioassay Water Quality Data: Table A3-1

Results:

The effluent did not affect the survival of the adults after 7 d of exposure (Table A3-2). Likewise, the effluent did not affect neonate production during the 7 d exposure (Tables A3-3 and A3-4).

TABLE A3-1. SUMMARY OF THE SECOND QUARTER FT. DETRICK WWTP
EFFLUENT BIOASSAY WATER QUALITY DATA FOR THE
CLADOCERAN 7-DAY TEST - DISSOLVED OXYGEN (MG/L)

	<u>Test Concentrations (Percent Effluent by Volume)</u>					
	0.0	10	18	32	56	100
<u>Day 0</u>						
0 H	8.4	8.4	8.3	8.3	8.2	8.7
<u>Day 1</u>						
0 H	8.2	8.2	8.2	8.2	8.2	8.3
24 H	8.0	8.0	7.9	7.8	8.3	8.4
<u>Day 2</u>						
0 H	8.5	8.3	8.3	8.2	8.3	8.4
24 H	8.2	8.1	8.0	8.1	8.4	8.3
<u>Day 3</u>						
0 H	8.5	8.5	8.5	8.4	8.6	8.6
24 H	8.1	8.0	7.9	8.0	8.3	8.2
<u>Day 4</u>						
0 H	8.3	8.1	8.1	8.1	8.1	8.0
24 H	8.0	7.9	7.9	7.8	8.0	7.9
<u>Day 5</u>						
0 H	8.2	8.0	8.0	8.3	8.1	8.0
24 H	8.0	7.8	7.9	7.9	7.9	7.7
<u>Day 6</u>						
0 H	8.3	8.1	8.1	8.1	8.2	8.0
24 H	8.2	8.3	8.4	8.1	8.3	8.3
<u>Day 7</u>						
24 H	8.1	8.0	8.1	8.0	8.1	8.2

TABLE A3-1. (CONTINUED) - pH

	<u>Test concentrations (Percent Effluent by Volume)</u>					
	0.0	10	18	32	56	100
<u>Day 0</u>						
0 H	7.06	7.17	7.17	7.14	7.07	6.69
<u>Day 1</u>						
0 H	7.03	7.13	7.16	7.14	7.10	6.85
24 H	7.16	7.29	7.34	7.42	7.55	7.54
<u>Day 2</u>						
0 H	6.47	6.52	6.71	6.79	6.85	6.85
24 H	7.23	7.39	7.42	7.51	7.52	7.51
<u>Day 3</u>						
0 H	7.52	7.55	7.57	7.57	7.55	7.43
24 H	6.64	6.69	6.78	6.91	7.03	7.15
<u>Day 4</u>						
0 H	6.38	6.48	6.56	6.73	6.79	6.95
24 H	6.50	6.73	6.81	6.95	7.07	7.11
<u>Day 5</u>						
0 H	6.35	6.42	6.50	6.57	6.68	6.79
24 H	6.49	6.69	6.77	6.89	7.00	7.01
<u>Day 6</u>						
0 H	6.36	6.27	6.33	6.43	6.57	6.58
24 H	6.41	6.52	6.80	6.96	7.14	7.24
<u>Day 7</u>						
24 H	6.31	6.53	6.75	6.91	7.07	7.21

TABLE A3-1. (CONTINUED) - CONDUCTIVITY (μ MHOS/CM)

	Test Concentrations (Percent Effluent by Volume)					
	0.0	10	18	32	56	100
<u>Day 0</u>						
0 H	230	270	300	360	465	540
<u>Day 1</u>						
0 H	240	240	300	320	380	500
24 H	270	270	310	370	470	520
<u>Day 2</u>						
0 H	170	175	185	310	440	530
24 H	260	240	320	340	480	530
<u>Day 3</u>						
0 H	170	200	200	310	450	530
24 H	190	230	260	340	470	510
<u>Day 4</u>						
0 H	180	270	305	430	440	530
24 H	190	230	270	300	460	500
<u>Day 5</u>						
0 H	190	280	310	400	450	520
24 H	180	220	280	290	450	490
<u>Day 6</u>						
0 H	190	215	250	290	430	540
24 H	200	220	275	340	500	500
<u>Day 7</u>						
24 H	210	240	300	360	470	500

TABLE A3-1. (CONTINUED) - ALKALINITY (MG/L AS CaCO_3)

	<u>Test Concentrations (Percent Effluent by Volume)</u>					
	0.0	10	18	32	56	100
<u>Day 0</u>						
0 H	50	85	90	75	75	60
<u>Day 1</u>						
0 H	60	80	95	85	80	70
24 H	55	90	95	80	70	65
<u>Day 2</u>						
0 H	60	85	90	80	75	65
24 H	50	85	90	80	75	65
<u>Day 3</u>						
0 H	60	80	85	85	80	70
24 H	55	75	85	75	70	65
<u>Day 4</u>						
0 H	55	75	80	85	75	65
24 H	60	70	80	70	75	65
<u>Day 5</u>						
0 H	60	70	80	90	80	70
24 H	55	60	75	75	70	60
<u>Day 6</u>						
0 H	65	65	75	85	80	70
24 H	60	60	70	80	80	65
<u>Day 7</u>						
24 H	60	65	65	75	80	60

TABLE A3-1. (CONTINUED) - HARDNESS (MG/L AS CaCO_3)

	Test Concentrations (Percent Effluent by Volume)					
	0.0	10	18	32	56	100
<u>Day 0</u>						
0 H	68	72	72	76	82	122
<u>Day 1</u>						
0 H	70	68	68	80	96	114
24 H	64	72	76	76	82	128
<u>Day 2</u>						
0 H	64	72	76	84	100	128
24 H	68	64	64	76	88	120
<u>Day 3</u>						
0 H	54	62	66	64	90	130
24 H	60	58	64	76	88	122
<u>Day 4</u>						
0 H	58	64	68	80	92	128
24 H	58	60	64	70	80	116
<u>Day 5</u>						
0 H	62	64	70	82	96	124
24 H	58	62	64	76	88	120
<u>Day 6</u>						
0 H	50	54	64	78	110	144
24 H	60	68	80	88	98	114
<u>Day 7</u>						
24 H	60	68	76	90	98	132

TABLE A3-1. (CONTINUED) - TEMPERATURE (°C)

	<u>Test Concentrations (Percent Effluent by Volume)</u>					
	0.0	10	18	32	56	100
<u>Day 0</u>						
0 H	24.9	25.0	25.0	25.1	25.1	25.1
<u>Day 1</u>						
0 H	25.0	25.0	25.0	25.0	25.0	25.1
<u>Day 2</u>						
0 H	25.0	25.0	25.0	25.0	24.9	24.9
<u>Day 3</u>						
0 H	24.9	24.9	24.9	24.9	24.9	24.9
<u>Day 4</u>						
0 H	24.8	24.8	24.9	25.0	25.0	25.0
<u>Day 5</u>						
0 H	24.9	24.9	25.0	25.0	25.0	25.0
<u>Day 6</u>						
0 H	25.0	25.0	25.0	25.0	24.9	24.9
<u>Day 7</u>						
24 H	24.9	25.0	25.0	25.0	25.0	25.0

TABLE A3-2. SURVIVAL OF CLADOCERAN ADULTS AFTER 7 DAYS OF EXPOSURE TO FT. DETRICK WWTP EFFLUENT DURING THE SECOND QUARTER TEST

Concentration (% Effluent by Volume)	Number Tested	No. Alive at End of Test	Percent Alive
JMD/WREC Control	10	10	100
10	10	10	100
18	10	10	100
32	10	10	100
56	10	10	100
100	10	10	100

TABLE A3-3. NUMBER OF YOUNG PRODUCED PER BROOD, TOTAL NUMBER OF YOUNG, AND MEAN NUMBER OF YOUNG PER BROOD DURING THE SECOND QUARTER TEST

Concentration (% Effluent by Volume)	Rep	Brood No. 1	Brood No. 2	Brood No. 3	Total Young	Mean Young Per Brood
UMD/WREC Control	1	4	8	16	28	9.3
	2	7	12	15	34	11.3
	3	6	11	18	35	11.7
	4	5	9	15	29	9.7
	5	7	8	15	30	10.0
	6	4	8	15	27	9.0
	7	6	10	16	32	10.7
	8	6	11	14	31	10.3
	9	5	9	15	29	9.7
	10	4	9	15	28	9.3
10	1	7	8	14	29	9.7
	2	6	8	14	28	9.3
	3	6	9	16	31	10.3
	4	5	7	16	28	9.3
	5	5	7	17	29	9.7
	6	6	7	18	31	10.3
	7	4	7	17	28	9.3
	8	6	7	18	31	10.3
	9	5	13	16	34	11.3
	10	6	9	17	32	10.7
18	1	8	5	16	29	9.7
	2	6	9	20	35	11.7
	3	5	7	15	27	9.0
	4	5	8	15	28	9.3
	5	5	12	14	31	10.3
	6	6	12	12	30	10.0
	7	5	9	18	32	10.7
	8	5	9	15	29	9.7
	9	6	9	17	32	10.7
	10	6	8	15	29	9.7

TABLE A3-3. (CONTINUED)

Concentration (% Effluent by Volume)	Rep	Brood No. 1	Brood No. 2	Brood No. 3	Total Young	Mean Young Per Brood
32	1	4	9	15	28	9.3
	2	6	8	16	30	10.0
	3	6	9	17	32	10.7
	4	5	11	16	32	10.7
	5	5	11	19	35	11.7
	6	4	7	15	26	8.7
	7	6	8	15	29	9.7
	8	5	9	19	33	11.0
	9	5	9	16	30	10.0
	10	5	9	17	31	10.3
56	1	5	11	13	29	9.7
	2	5	9	16	30	10.0
	3	5	8	18	31	10.3
	4	6	8	18	32	10.7
	5	5	8	15	28	9.3
	6	5	9	19	33	11.0
	7	5	10	15	30	10.0
	8	5	10	15	30	10.0
	9	5	9	12	26	8.7
	10	5	8	15	28	9.3
100	1	6	8	17	31	10.3
	2	7	9	15	31	10.3
	3	5	7	16	28	9.3
	4	5	7	16	28	9.3
	5	6	7	15	28	9.3
	6	4	9	14	27	9.0
	7	5	8	16	29	9.7
	8	5	7	15	27	9.0
	9	4	9	17	30	10.0
	10	4	9	18	31	10.3

TABLE A3-4. STATISTICAL ANALYSIS OF TOTAL NEONATE PRODUCTION
DURING THE SECOND QUARTER TEST

Data Transformation:

None

Chi-Square Test for Normality:

Calculate test statistic:	6.66
Alpha value:	0.01
Critical value:	13.27
Conclusion:	Fail to reject the null hypothesis that the data are normally distributed

Bartlett's Test for Homogeneity of Variances:

Calculated test statistic:	2.73
Alpha value:	0.01
Critical value:	15.09
Conclusion:	Fail to reject the null hypothesis that the variances are homogenous

ANOVA:

Calculated test statistic:	0.63
Alpha value:	0.05
Critical value:	2.45
Conclusion:	Fail to reject the null hypothesis that all groups are equal

APPENDIX 4

FATHEAD MINNOW 7-D SURVIVAL AND GROWTH TEST CONDUCTED ON FT. DETRICK WWTP EFFLUENT (SECOND QUARTER TEST)

Name of Test:	FATHEAD 7-D CHRONIC
Test Method:	EPA/600/4-89/001
Type of Test:	Static renewal (every 24 h)
Date:	January 11 - January 18, 1993
Investigators:	S. D. Turley
Laboratory:	UMD/WREC
Effluent:	
Source:	Ft. Detrick WWTP
Chemical Characteristics:	Appendix 9
Dilution Water:	
Source:	UMD/WREC nonchlorinated tap water
Chemical Characteristics:	Table A4-1
Test Organism:	
Scientific Name:	<u>Pimephales promelas</u>
Age:	Newly hatched larvae <24 h old at start of test
Source:	UMD/WREC culture
Experimental Chambers:	
Material:	500 mL glass beakers
Volume:	250 mL
No. Organisms Per Replicate:	10
No. Organisms Per Treatment:	40
Loading:	<0.5 g/L
Lighting:	Fluorescent; 50-100 foot candles
Metering System:	n/a

Flow Rate: n/a
Aeration: None
Endpoints: Mortality; growth
Bioassay Water Quality Data: See Table A4-1
Results:

The effluent caused a statistically significant ($\alpha = 0.05$) reduction in survival of fathead minnow larvae after 7 d of exposure in the of 56% effluent by volume concentration only (Tables A4-2, A4-3, and A4-4). Since no statistically significant mortality occurred in any other concentrations including 100% effluent, the reduction in survival at 56% effluent by volume is most likely due to statistical chance. The effluent did not cause a decrease in fathead minnow larval growth (Tables A4-5 and A4-6).

TABLE A4-1. SUMMARY OF THE SECOND QUARTER FT. DETRICK WWTP
EFFLUENT BIOASSAY WATER QUALITY DATA FOR THE FATHEAD
MINNOW 7-DAY TEST - DISSOLVED OXYGEN (MG/L)

	<u>Test Concentrations (Percent Effluent by Volume)</u>					
	0.0	10	18	32	56	100
<u>Day 0</u>						
0 H	8.7	8.5	8.7	8.6	8.6	8.7
<u>Day 1</u>						
0 H	8.7	8.7	8.7	8.4	8.5	8.5
24 H	6.0	6.1	6.2	6.0	5.9	6.4
<u>Day 2</u>						
0 H	8.5	8.5	8.3	8.3	8.5	8.7
24 H	5.5	5.5	5.7	5.7	5.8	5.9
<u>Day 3</u>						
0 H	8.3	8.2	8.2	8.2	8.3	8.3
24 H	5.5	5.7	5.8	5.6	5.6	5.7
<u>Day 4</u>						
0 H	8.3	8.3	8.3	8.4	8.3	8.3
24 H	5.9	6.0	5.7	5.5	5.5	5.6
<u>Day 5</u>						
0 H	8.6	8.6	8.5	8.6	8.5	8.2
24 H	6.5	6.5	6.6	6.7	6.8	6.8
<u>Day 6</u>						
0 H	8.7	8.7	8.8	8.7	8.6	8.7
24 H	6.3	5.9	6.1	6.3	6.5	7.1
<u>Day 7</u>						
24 H	6.9	6.8	7.0	6.7	6.8	6.7

TABLE A4-1. (CONTINUED) - pH

	<u>Test concentrations (Percent Effluent by Volume)</u>					
	0.0	10	18	32	56	100
<u>Day 0</u>						
0 H	7.09	6.78	6.87	6.90	6.84	6.59
<u>Day 1</u>						
0 H	7.03	7.11	7.10	7.06	6.98	6.59
24 H	6.77	6.84	6.89	6.92	6.94	6.96
<u>Day 2</u>						
0 H	6.91	7.05	7.10	7.14	7.10	7.00
24 H	6.89	6.90	6.96	6.99	7.01	7.00
<u>Day 3</u>						
0 H	7.30	7.50	7.57	7.57	7.51	7.23
24 H	6.92	7.29	7.33	7.36	7.36	7.32
<u>Day 4</u>						
0 H	6.93	7.19	7.24	7.22	7.12	6.88
24 H	6.85	6.95	6.98	6.99	7.01	6.98
<u>Day 5</u>						
0 H	7.03	7.28	7.35	7.37	7.24	6.98
24 H	6.96	7.05	7.11	7.14	7.15	7.11
<u>Day 6</u>						
0 H	6.80	7.22	7.26	7.23	7.15	6.88
24 H	6.90	6.89	6.91	6.95	6.98	6.97
<u>Day 7</u>						
24 H	6.93	6.94	7.00	7.00	7.06	6.82

TABLE A4-1. (CONTINUED) - CONDUCTIVITY (μ MHOS/CM)

	<u>Test Concentrations (Percent Effluent by Volume)</u>					
	0.0	10	18	32	56	100
<u>Day 0</u>						
0 H	240	280	320	375	480	540
<u>Day 1</u>						
0 H	250	295	330	400	500	520
24 H	290	300	330	385	480	510
<u>Day 2</u>						
0 H	230	230	280	360	475	520
24 H	285	280	320	370	460	500
<u>Day 3</u>						
0 H	180	290	280	380	490	540
24 H	225	290	340	375	495	540
<u>Day 4</u>						
0 H	190	270	300	370	470	530
24 H	200	280	320	385	495	540
<u>Day 5</u>						
0 H	200	290	320	400	420	560
24 H	230	310	350	400	490	520
<u>Day 6</u>						
0 H	200	300	320	380	420	560
24 H	220	290	370	400	490	510
<u>Day 7</u>						
24 H	290	315	335	420	610	800

TABLE A4-1. (CONTINUED) - ALKALINITY (MG/L AS CaCO_3)

	<u>Test Concentrations (Percent Effluent by Volume)</u>					
	0.0	10	18	32	56	100
<u>Day 0</u>						
0 H	35	85	95	75	70	60
<u>Day 1</u>						
0 H	60	80	90	80	75	65
24 H	55	80	85	80	75	65
<u>Day 2</u>						
0 H	65	85	95	85	80	70
24 H	60	80	90	75	70	70
<u>Day 3</u>						
0 H	65	80	90	90	85	75
24 H	65	80	85	80	75	70
<u>Day 4</u>						
0 H	60	75	85	90	80	70
24 H	60	70	80	85	75	70
<u>Day 5</u>						
0 H	65	70	80	85	85	75
24 H	55	75	80	80	75	70
<u>Day 6</u>						
0 H	60	70	85	90	80	70
24 H	60	65	75	75	70	65
<u>Day 7</u>						
24 H	60	90	85	90	85	65

TABLE A4-1. (CONTINUED) - HARDNESS (MG/L AS CaCO_3)

	Test Concentrations (Percent Effluent by Volume)					
	0.0	10	18	32	56	100
<u>Day 0</u>						
0 H	56	66	72	88	102	122
<u>Day 1</u>						
0 H	52	66	58	66	78	100
24 H	62	72	76	80	88	108
<u>Day 2</u>						
0 H	64	66	66	72	88	128
24 H	58	72	62	70	84	110
<u>Day 3</u>						
0 H	74	72	76	78	100	140
24 H	68	66	72	76	98	126
<u>Day 4</u>						
0 H	62	66	68	78	96	138
24 H	66	64	70	72	92	132
<u>Day 5</u>						
0 H	56	72	76	92	100	128
24 H	60	60	64	76	92	130
<u>Day 6</u>						
0 H	62	70	78	88	102	130
24 H	60	66	70	80	96	132
<u>Day 7</u>						
24 H	66	70	86	88	122	142

TABLE A4-1. (CONTINUED) - TEMPERATURE (°C)

	<u>Test Concentrations (Percent Effluent by Volume)</u>					
	0.0	10	18	32	56	100
<u>Day 0</u>						
0 H	25.0	25.0	25.0	25.1	25.1	25.1
<u>Day 1</u>						
0 H	24.9	24.9	25.0	25.0	25.1	25.2
<u>Day 2</u>						
0 H	24.9	24.9	24.9	24.9	24.9	24.9
<u>Day 3</u>						
0 H	25.0	25.0	24.9	24.9	24.9	24.9
<u>Day 4</u>						
0 H	25.0	25.0	25.0	25.1	25.1	25.1
<u>Day 5</u>						
0 H	24.9	24.9	25.0	25.0	25.1	25.1
<u>Day 6</u>						
0 H	25.0	25.0	25.0	25.0	25.0	25.0
<u>Day 7</u>						
24 H	25.0	25.0	25.0	25.0	25.0	25.0

TABLE A4-2. SURVIVAL OF FATHEAD MINNOW LARVAE AFTER 7 DAYS OF EXPOSURE TO FT. DETRICK WWTP EFFLUENT DURING THE SECOND QUARTER TEST

Concentration (% Effluent by Volume)	Rep	Number Tested	No. Alive at End of Test	Percent Alive
UMD/WREC Control	1	10	8	80
	2	10	10	100
	3	10	9	90
	4	10	10	100
10	1	10	8	80
	2	10	9	90
	3	10	8	80
	4	10	9	90
18	1	10	8	80
	2	10	7	70
	3	10	9	90
	4	10	8	80
32	1	10	9	90
	2	10	8	80
	3	10	8	80
	4	10	7	70
56	1	10	7	70
	2	10	8	80
	3	10	7	70
	4	10	7	70
100	1	10	8	80
	2	10	8	80
	3	10	9	90
	4	10	8	80

TABLE A4-3. STATISTICAL ANALYSIS OF LARVAL FATHEAD MINNOW
SURVIVAL DURING THE SECOND QUARTER TEST

Data Transformation:

Arc-sine square-root transformation

Chi-Square Test for Normality:

Calculated test statistic:	4.52
Alpha value:	0.01
Critical value:	13.28
Conclusion:	Fail to reject the null hypothesis that the data are normally distributed

Bartlett's Test for Homogeneity of Variances:

Calculated test statistic:	2.89
Alpha value:	0.01
Critical value:	15.09
Conclusion:	Fail to reject the null hypothesis that the variances are homogenous

ANOVA:

Calculated test statistic:	2.67
Alpha value:	0.05
Critical value:	2.77
Conclusion:	Reject the null hypothesis that all groups are equal

Dunnett's Test:

Calculated test statistic:	See Table A4-4
Alpha value:	0.05
Critical value:	2.41
Conclusion:	Reject the null hypothesis that all groups are equal (see Table A4-4)

Table A4-4. RESULTS OF DUNNETT'S TEST ON LARVAL FATHEAD MINNOW SURVIVAL DURING THE SECOND QUARTER TEST

Concentration (% Effluent by Volume)	No. of Reps	Mean Percent Survival	T Statistic	Significance
UMD/WREC Control	4	90		
10	4	85	1.136	
18	4	80	2.097	
32	4	80	2.097	
56	4	72.5	3.491	*
100	4	82.5	1.605	

* Significantly different at alpha = 0.05 (Dunnett's critical value = 2.41).

TABLE A4-5. GROWTH OF FATHEAD MINNOW LARVAE AFTER 7 DAYS OF EXPOSURE TO FT. DETRICK WWTP EFFLUENT DURING THE SECOND QUARTER TEST

Concentration (% Effluent by Volume)	Rep	Dry Weight (mg)	Mean Dry Weight (mg)
UMD/WREC Control	1	0.41	0.38
	2	0.35	
	3	0.31	
	4	0.44	
10	1	0.30	0.32
	2	0.32	
	3	0.30	
	4	0.34	
18	1	0.39	0.39
	2	0.38	
	3	0.31	
	4	0.50	
32	1	0.38	0.36
	2	0.33	
	3	0.31	
	4	0.43	
56	1	0.39	0.37
	2	0.37	
	3	0.33	
	4	0.38	
100	1	0.32	0.37
	2	0.23	
	3	0.43	
	4	0.48	

TABLE A4-6. STATISTICAL ANALYSIS OF LARVAL FATHEAD MINNOW GROWTH
DURING THE SECOND QUARTER TEST

Data Transformation:

None

Chi-Square Test for Normality:

Calculate test statistic:	5.02
Alpha value:	0.01
Critical value:	13.28
Conclusion:	Fail to reject the null hypothesis that the data are normally distributed

Bartlett's Test for Homogeneity of Variances:

Calculated test statistic:	8.22
Alpha value:	0.01
Critical value:	15.09
Conclusion:	Fail to reject the null hypothesis that the variances are homogenous

ANOVA:

Calculated test statistic:	0.75
Alpha value:	0.05
Critical value:	2.77
Conclusion:	Fail to reject the null hypothesis that all groups are equal

APPENDIX 5

CLADOCERAN 48-H SURVIVAL TEST CONDUCTED ON FT. DETRICK WWTP EFFLUENT (THIRD QUARTER TEST)

Name of Test:	CERIODAPHNIA 48-HOUR ACUTE
Test Method:	EPA/600/4-90/027
Type of Test:	Static renewal (every 24 h)
Date:	April 5 - April 7, 1993
Investigator:	S. D. Turley
Laboratory:	UMD/WREC
Effluent:	
Source:	Ft. Detrick WWTP
Chemical Characteristics:	Appendix 9
Dilution Water:	
Source:	20% Perrier; 80% RO Water
Chemical Characteristics:	Table A5-1
Test Organism:	
Scientific Name:	<u>Ceriodaphnia dubia</u>
Wet Weight:	n/a
Length:	n/a
Age:	<24 h; all released within a 4-h period
Source:	UMD/WREC Culture
Experimental Chambers:	
Material:	30-mL glass beakers
Volume:	15 mL
No. Organisms Per Treatment:	20
Loading:	5 organisms/beaker
Lighting:	Fluorescent; 50-100 foot candles
Metering System:	n/a

Flow Rate:	n/a
Aeration:	Prior to each renewal
Endpoints:	Mortality of adults
Bioassay Water Quality Data:	Table A5-1
Results:	

The effluent did not cause sufficient mortality in the cladoceran bioassay to calculate a 48-h LC50 (Table A5-2).

TABLE A5-1. SUMMARY OF THE THIRD QUARTER FT. DETRICK WWTP
EFFLUENT BIOASSAY WATER QUALITY DATA FOR THE
CLADOCERAN 48-HOUR TEST - DISSOLVED OXYGEN (MG/L)

	<u>Test Concentrations (Percent Effluent by Volume)</u>					
	0.0	10	18	32	56	100
<u>Day 0</u>						
0 H	8.6	8.2	8.3	8.3	8.3	8.5
<u>Day 1</u>						
0 H	8.3	8.3	8.2	8.1	8.0	8.1
24 H	7.1	7.0	6.9	6.9	6.8	7.0
<u>Day 2</u>						
24 H	8.0	8.1	8.1	8.0	7.7	7.6

TABLE A5-1. (CONTINUED) - pH

	<u>Test concentrations (Percent Effluent by Volume)</u>					
	0.0	10	18	32	56	100
<u>Day 0</u>						
0 H	7.74	7.76	7.75	7.69	7.58	7.38
<u>Day 1</u>						
0 H	7.66	7.66	7.64	7.58	7.48	7.21
24 H	7.59	7.51	7.47	7.45	7.40	7.36
<u>Day 2</u>						
24 H	7.63	7.53	7.46	7.41	7.35	7.30

TABLE A5-1. (CONTINUED) - CONDUCTIVITY (μ MHOS/CM)

	<u>Test Concentrations (Percent Effluent by Volume)</u>					
	0.0	10	18	32	56	100
<u>Day 0</u>						
0 H	320	340	370	420	600	770
<u>Day 1</u>						
0 H	315	340	360	420	610	780
24 H	350	365	390	440	600	740
<u>Day 2</u>						
24 H	350	370	390	420	590	700

TABLE A5-1. (CONTINUED) - ALKALINITY (MG/L AS CaCO_3)

	<u>Test Concentrations (Percent Effluent by Volume)</u>					
	0.0	10	18	32	56	100
<u>Day 0</u>						
0 H	85	80	85	85	90	90
<u>Day 1</u>						
0 H	90	85	90	90	95	90
<u>Day 2</u>						
24 H	80	80	80	85	90	90

TABLE A5-1. (CONTINUED) - HARDNESS (MG/L AS CaCO_3)

	<u>Test Concentrations (Percent Effluent by Volume)</u>					
	0.0	10	18	32	56	100
<u>Day 0</u>						
0 H	68	80	92	106	136	164
<u>Day 1</u>						
0 H	64	72	84	108	148	176
<u>Day 2</u>						
24 H	72	82	94	106	120	176

TABLE A5-1. (CONTINUED) - TEMPERATURE (°C)

	<u>Test Concentrations (Percent Effluent by Volume)</u>					
	0.0	10	18	32	56	100
<u>Day 0</u>						
0 H	25.0	25.0	25.0	25.0	25.1	25.1
<u>Day 1</u>						
0 H	25.0	25.0	25.0	25.0	25.0	25.0
<u>Day 2</u>						
24 H	25.0	25.0	25.0	25.0	25.0	25.0

TABLE A5-2. SURVIVAL OF CLADOCERANS AFTER 48 HOURS OF EXPOSURE TO FT. DETRICK WWTP EFFLUENT DURING THE THIRD QUARTER TEST

Concentration (% Effluent by Volume)	Number Tested	No. Alive at End of Test	Percent Alive
UMD/WREC Control	20	20	100
10	20	20	100
18	20	20	100
32	20	20	100
56	20	20	100
100	20	17	85

APPENDIX 6

FATHEAD MINNOW 48-H SURVIVAL CONDUCTED ON FT. DETRICK WWTP EFFLUENT (THIRD QUARTER TEST)

Name of Test:	FATHEAD 48 H ACUTE
Test Method:	EPA/600/4-90/027
Type of Test:	Static renewal (every 24 h)
Date:	April 5 - April 7, 1993
Investigators:	S. D. Turley
Laboratory:	UMD/WREC
Effluent:	
Source:	Ft. Detrick WWTP
Chemical Characteristics:	Appendix 9
Dilution Water:	
Source:	UMD/WREC nonchlorinated tap water
Chemical Characteristics:	Table A6-1
Test Organism:	
Scientific Name:	<u>Pimephales promelas</u>
Age:	10 d old at start of test
Source:	UMD/WREC culture
Experimental Chambers:	
Material:	500 mL glass beakers
Volume:	250 mL
No. Organisms Per Replicate:	10
No. Organisms Per Treatment:	20
Loading:	<0.5 g/L
Lighting:	Fluorescent; 50-100 foot candles
Metering System:	n/a

Flow Rate: n/a
Aeration: None
Endpoints: Mortality
Bioassay Water Quality Data: See Table A6-1

Results:

The effluent did not affect the survival of fathead minnows after 48 h of exposure (Table A6-2).

TABLE A6-1. SUMMARY OF THE THIRD QUARTER FT. DETRICK WWTP
EFFLUENT BIOASSAY WATER QUALITY DATA FOR THE FATHEAD
MINNOW 48-HOUR TEST - DISSOLVED OXYGEN (MG/L)

	<u>Test Concentrations (Percent Effluent by Volume)</u>					
	0.0	10	18	32	56	100
<u>Day 0</u>						
0 H	8.6	8.2	8.3	8.3	8.3	8.5
<u>Day 1</u>						
0 H	8.3	8.3	8.2	8.1	8.0	8.1
24 H	7.2	7.1	7.1	7.0	7.1	7.2
<u>Day 2</u>						
24 H	7.9	7.8	7.7	7.7	7.6	7.8

TABLE A6-1. (CONTINUED) - pH

		<u>Test concentrations (Percent Effluent by Volume)</u>					
		0.0	10	18	32	56	100
<u>Day 0</u>							
0 H		7.74	7.76	7.75	7.69	7.58	7.38
<u>Day 1</u>							
0 H		7.66	7.66	7.64	7.58	7.48	7.21
24 H		7.62	7.54	7.50	7.47	7.42	7.32
<u>Day 2</u>							
24 H		7.69	7.56	7.49	7.43	7.40	7.29

TABLE A6-1. (CONTINUED) - CONDUCTIVITY (μ MHOS/CM)

	<u>Test Concentrations (Percent Effluent by Volume)</u>					
	0.0	10	18	32	56	100
<u>Day 0</u>						
0 H	320	340	370	420	600	770
<u>Day 1</u>						
0 H	315	340	360	420	610	780
24 H	340	370	390	440	620	730
<u>Day 2</u>						
24 H	340	360	385	450	620	750

TABLE A6-1. (CONTINUED) - ALKALINITY (MG/L AS CaCO_3)

	<u>Test Concentrations (Percent Effluent by Volume)</u>					
	0.0	10	18	32	56	100
<u>Day 0</u>						
0 H	85	80	85	85	90	90
<u>Day 1</u>						
0 H	90	85	90	90	95	90
<u>Day 2</u>						
24 H	80	85	85	90	90	95

TABLE A6-1. (CONTINUED) - HARDNESS (MG/L AS CaCO_3)

	<u>Test Concentrations (Percent Effluent by Volume)</u>					
	0.0	10	18	32	56	100
<u>Day 0</u>						
0 H	68	80	92	106	136	164
<u>Day 1</u>						
0 H	64	72	84	108	148	176
<u>Day 2</u>						
24 H	70	80	90	110	112	170

TABLE A6-1. (CONTINUED) - TEMPERATURE (°C)

	<u>Test Concentrations (Percent Effluent by Volume)</u>					
	0.0	10	18	32	56	100
<u>Day 0</u>						
0 H	25.0	25.0	25.0	25.0	25.0	25.0
<u>Day 1</u>						
0 H	25.0	25.0	25.0	25.0	25.0	25.0
<u>Day 2</u>						
0 H	25.0	25.0	25.0	25.0	25.0	25.0

TABLE A6-2. SURVIVAL OF FATHEAD MINNOW LARVAE AFTER 48 HOURS OF EXPOSURE TO FT. DETRICK WWTP EFFLUENT DURING THE THIRD QUARTER TEST

Concentration (% Effluent by Volume)	Rep	Number Tested	No. Alive at End of Test	Percent Alive
UMD/WREC Control	1	10	10	100
	2	10	10	100
10	1	10	10	100
	2	10	10	100
18	1	10	10	100
	2	10	10	100
32	1	10	10	100
	2	10	10	100
56	1	10	10	100
	2	10	10	100
100	1	10	10	100
	2	10	10	100

APPENDIX 7

CLADOCERAN 48-H SURVIVAL TEST CONDUCTED ON FT. DETRICK WWTP EFFLUENT (FOURTH QUARTER TEST)

Name of Test:	CERIODAPHNIA 48-HOUR ACUTE
Test Method:	EPA/600/4-90/027
Type of Test:	Static renewal (every 24 h)
Date:	July 12 - July 14, 1993
Investigator:	S. D. Turley
Laboratory:	UMD/WREC
Effluent:	
Source:	Ft. Detrick WWTP
Chemical Characteristics:	Appendix 9
Dilution Water:	
Source:	20% Perrier; 80% RO Water
Chemical Characteristics:	Table A7-1
Test Organism:	
Scientific Name:	<u>Ceriodaphnia dubia</u>
Wet Weight:	n/a
Length:	n/a
Age:	<24 h; all released within a 4-h period
Source:	UMD/WREC Culture
Experimental Chambers:	
Material:	30-mL glass beakers
Volume:	15 mL
No. Organisms Per Treatment:	20
Loading:	5 organisms/beaker
Lighting:	Fluorescent; 50-100 foot candles
Metering System:	n/a

Flow Rate:	n/a
Aeration:	Prior to each renewal
Endpoints:	Mortality of adults
Bioassay Water Quality Data:	Table A7-1
Results:	

The effluent did not cause sufficient mortality in the cladoceran bioassay to calculate a 48-h LC50 (Table A7-2).

TABLE A7-1. SUMMARY OF THE FOURTH QUARTER FT. DETRICK WWTP
EFFLUENT BIOASSAY WATER QUALITY DATA FOR THE
CLADOCERAN 48-HOUR TEST - DISSOLVED OXYGEN (MG/L)

	<u>Test Concentrations (Percent Effluent by Volume)</u>					
	0.0	10	18	32	56	100
<u>Day 0</u>						
0 H	8.0	8.1	8.1	8.1	8.2	8.3
<u>Day 1</u>						
0 H	8.2	8.0	8.0	8.1	7.9	8.0
24 H	7.9	7.7	7.8	7.8	7.8	7.8
<u>Day 2</u>						
24 H	7.9	7.9	7.9	7.8	8.0	8.1

TABLE A7-1. (CONTINUED) - pH

	<u>Test concentrations (Percent Effluent by Volume)</u>					
	0.0	10	18	32	56	100
<u>Day 0</u>						
0 H	7.68	7.51	7.41	7.41	7.44	7.53
<u>Day 1</u>						
0 H	7.05	7.25	7.25	7.22	7.16	7.24
24 H	7.57	7.56	7.36	7.37	7.40	7.42
<u>Day 2</u>						
24 H	6.54	6.58	6.71	6.91	7.12	7.42

TABLE A/-1. (CONTINUED) - CONDUCTIVITY (μ MHOS/CM)

	<u>Test Concentrations (Percent Effluent by Volume)</u>					
	0.0	10	18	32	56	100
<u>Day 0</u>						
0 H	120	130	160	210	310	600
<u>Day 1</u>						
0 H	125	140	160	200	300	580
24 H	120	130	150	200	280	590
<u>Day 2</u>						
24 H	110	130	160	210	310	600

TABLE A7-1. (CONTINUED) - ALKALINITY (MG/L AS CaCO_3)

	<u>Test Concentrations (Percent Effluent by Volume)</u>					
	0.0	10	18	32	56	100
<u>Day 0</u>						
0 H	25	25	30	35	40	50
<u>Day 1</u>						
0 H	25	30	25	35	40	50
<u>Day 2</u>						
24 H	20	30	35	40	40	50

TABLE A7-1. (CONTINUED) - HARDNESS (MG/L AS CaCO_3)

	<u>Test Concentrations (Percent Effluent by Volume)</u>					
	0.0	10	18	32	56	100
<u>Day 0</u>						
0 H	20	36	40	66	90	148
<u>Day 1</u>						
0 H	20	24	28	64	90	136
<u>Day 2</u>						
24 H	36	36	40	66	90	148

TABLE A7-1. (CONTINUED) - TEMPERATURE (°C)

	<u>Test Concentrations (Percent Effluent by Volume)</u>					
	0.0	10	18	32	56	100
<u>Day 0</u>						
0 H	25.0	25.0	25.0	25.0	25.0	25.0
<u>Day 1</u>						
0 H	25.0	25.0	25.0	25.0	25.0	25.0
<u>Day 2</u>						
24 H	25.0	25.0	25.0	25.0	25.0	25.0

TABLE A7-2. SURVIVAL OF CLADOCERANS AFTER 48 HOURS OF EXPOSURE TO FT. DETRICK WWTP EFFLUENT DURING THE FOURTH QUARTER TEST

Concentration (% Effluent by Volume)	Number Tested	No. Alive at End of Test	Percent Alive
UMD/WREC Control	20	20	100
10	20	20	100
18	20	20	100
32	20	20	100
56	20	20	100
100	20	19	95

APPENDIX 8

FATHEAD MINNOW 48-H SURVIVAL CONDUCTED ON FT. DETRICK WWTP EFFLUENT (FOURTH QUARTER TEST)

Name of Test:	FATHEAD 48 H ACUTE
Test Method:	EPA/600/4-90/027
Type of Test:	Static renewal (every 24 h)
Date:	July 12 - July 14, 1993
Investigators:	S. D. Turley
Laboratory:	UMD/WREC
Effluent:	
Source:	Ft. Detrick WWTP
Chemical Characteristics:	Appendix 9
Dilution Water:	
Source:	UMD/WREC nonchlorinated tap water
Chemical Characteristics:	Table A8-1
Test Organism:	
Scientific Name:	<u>Pimephales promelas</u>
Age:	10 d old
Source:	at start of test UMD/WREC culture
Experimental Chambers:	
Material:	500 mL glass beakers
Volume:	250 mL
No. Organisms Per Replicate:	10
No. Organisms Per Treatment:	20
Loading:	<0.5 g/L
Lighting:	Fluorescent; 50-100 foot candles
Metering System:	n/a

Flow Rate: n/a
Aeration: None
Endpoints: Mortality
Bioassay Water Quality Data: See Table A8-1

Results:

The effluent did not affect the survival of fathead minnows after 48 h of exposure (Table A8-2).

TABLE A8-1. SUMMARY OF THE FOURTH QUARTER FT. DETRICK WWTP
EFFLUENT BIOASSAY WATER QUALITY DATA FOR THE FATHEAD
MINNOW 48-HOUR TEST - DISSOLVED OXYGEN (MG/L)

	<u>Test Concentrations (Percent Effluent by Volume)</u>					
	0.0	10	18	32	56	100
<u>Day 0</u>						
0 H	8.4	8.4	8.4	8.4	8.3	8.3
<u>Day 1</u>						
0 H	8.0	7.9	7.9	7.9	7.9	7.9
24 H	7.7	7.6	7.6	7.6	7.6	7.5
<u>Day 2</u>						
24 H	7.7	7.6	7.5	7.5	7.5	7.5

TABLE A8-1. (CONTINUED) - pH

	<u>Test concentrations (Percent Effluent by Volume)</u>					
	0.0	10	18	32	56	100
<u>Day 0</u>						
0 H	8.21	8.16	8.15	8.09	7.97	7.53
<u>Day 1</u>						
0 H	8.32	8.32	8.31	8.28	8.13	7.67
24 H	7.73	7.76	7.64	7.63	7.59	7.40
<u>Day 2</u>						
24 H	7.81	7.66	7.51	7.48	7.45	7.37

TABLE A8-1. (CONTINUED) - CONDUCTIVITY (μ MHOS/CM)

	<u>Test Concentrations (Percent Effluent by Volume)</u>					
	0.0	10	18	32	56	100
<u>Day 0</u>						
0 H	270	290	310	400	450	600
<u>Day 1</u>						
0 H	250	300	300	390	440	560
24 H	265	280	310	380	440	590
<u>Day 2</u>						
24 H	270	280	310	380	460	600

TABLE A8-1. (CONTINUED) - ALKALINITY (MG/L AS CaCO_3)

	<u>Test Concentrations (Percent Effluent by Volume)</u>					
	0.0	10	18	32	56	100
<u>Day 0</u>						
0 H	125	120	105	80	75	55
<u>Day 1</u>						
0 H	120	120	110	85	70	50
<u>Day 2</u>						
24 H	120	120	105	80	65	50

TABLE A8-1. (CONTINUED) - HARDNESS (MG/L AS CaCO_3)

	<u>Test Concentrations (Percent Effluent by Volume)</u>					
	0.0	10	18	32	56	100
<u>Day 0</u>						
0 H	68	72	80	90	110	140
<u>Day 1</u>						
0 H	72	80	88	96	110	150
<u>Day 2</u>						
24 H	76	80	88	96	102	148

TABLE A8-1. (CONTINUED) - TEMPERATURE (°C)

	<u>Test Concentrations (Percent Effluent by Volume)</u>					
	0.0	10	18	32	56	100
<u>Day 0</u>						
0 H	25.0	25.0	25.0	25.0	25.0	25.0
<u>Day 1</u>						
0 H	25.0	25.0	25.0	25.0	25.0	24.9
<u>Day 2</u>						
0 H	25.0	25.0	25.0	25.0	25.0	25.0

TABLE A8-2. SURVIVAL OF FATHEAD MINNOW LARVAE AFTER 48 HOURS OF EXPOSURE TO FT. DETRICK WWTP EFFLUENT DURING THE FOURTH QUARTER TEST

Concentration (% Effluent by Volume)	Rep	Number Tested	No. Alive at End of Test	Percent Alive
UMD/WREC Control	1	10	10	100
	2	10	10	100
10	1	10	10	100
	2	10	10	100
18	1	10	10	100
	2	10	10	100
32	1	10	10	100
	2	10	10	100
56	1	10	10	100
	2	10	10	100
100	1	10	10	100
	2	10	10	100

APPENDIX 9

INITIAL GENERAL WATER QUALITY AND PRIORITY POLLUTANT
ANALYSIS OF THE FT. DETRICK WWTP EFFLUENT

Client: University of MD-AES Office: Box 169 (Cheston Ln.) Contact: Dennis Burton Phone: (410)827-8056
 Date: November 30, 1992 Queenstown, MD 21658
 Project: Ft. Detrick WWTP

CASE NARRATIVE

Analytical work for this project met QA/QC criteria. Library search performed on the sample for semi-volatiles yielded 12 peaks with estimated total concentration of 102 ppb. Probabilities of matches with compounds in the Ion chromatogram database library ranged from 15% to 70%, in all cases lower than the normal applicable threshold for declaring an identification of the peak. A copy of the library search is attached; further analytical testing would be required for conclusive identification of the observed compound peaks. The library search for volatiles yielded no information of significance.

Daniel Carey
 Daniel Carey
 Manager
 Analytical Laboratory

BQL = "Below Quantitation Limit"

Note: Soil and solid waste samples are reported on a dry weight basis.

Client: University of MD-AES

Date: November 30, 1992

Project: Ft. Detrick WWTP

Office: Box 169 (Cheston Ln.)

Queenstown, MD 21658

Contact: Dennis Burton

Phone: (410)827-8056

Matrix: Water

Lab #	Client ID	Reference Method	Parameter	Quantitation Limit mg/L	Analytical Results mg/L	Date Collected	Date Received	Date Analyzed
1	Ft. Detrick WWTP	EPA 300.0	Chloride	1	110	10/26/92	10/26/92	11/06/92

A9-3

BQL = "Below Quantitation Limit"

Note: Soil and solid waste samples are reported on a dry weight basis.

Client: University of MD-AES

Date: November 30, 1992

Project: Ft. Detrick WWTP

Office: Box 169 (Cheston Ln.)

Queenstown, MD 21658

Contact: Dennis Burton

Phone: (410)827-8056

Matrix: Water

Lab #

Reference Method

Parameter

Quantitation Limit
mg/L

Analytical Results
mg/L

Date Collected

Date Received

Date Analyzed

1

Ft. Detrick
WWTP

EPA 310.1

Alkalinity

5

76

10/26/92

10/26/92

11/04/92

BQL = "Below Quantitation Limit"

Note: Soil and solid waste samples are reported on a dry weight basis.

Client: University of MD-AES
Date: November 30, 1992
Project: Ft. Detrick WWTP

Office: Box 169 (Cheston Ln.)
Queenstown, MD 21658

Contact: Dennis Burton **Phone:** (410)827-8056

Matrix:	Water								
Lab #	Client ID	Reference Method	Parameter	Quantitation Limit mg/L	Concentration Detected mg/L	Date Collected	Date Received	Date Analyzed	
1	Ft. Detrick WWTP	EPA 340.1	Fluoride	0.1	0.90	10/26/92	10/26/92	11/05/92	

A9-5

BQL = "Below Quantitation Limit"
Note: Soil and solid waste samples are reported on a dry weight basis.

Client: University of MD-AES
Date: November 30, 1992
Project: Ft. Detrick WWTP

Contact: Dennis Burton **Phone:** (410)827-8056

Office: Box 169 (Cheston Ln.)
Queenstown, MD 21658

Matrix: Water

Lab #	Client ID	Reference Method	Parameter	Results µmbos/cm	Date Collected	Date Received	Date Analyzed
1	Ft. Detrick WWTP	EPA 120.1	Conductivity	820	10/26/92	10/26/92	10/28/92

BQL = "Below Quantitation Limit"
Note: Soil and solid waste samples are reported on a dry weight basis.

Client: University of MD-AES

Date: November 30, 1992

Project: Ft. Detrick WWTP

Office: Box 169 (Cheston Ln.)
Queenstown, MD 21658

Contact: Dennis Burton

Phone: (410)827-8056

Matrix: Water

Lab #	Client ID	Reference Method	Parameter	Quantitation Limit mg/L	Concentration Detected mg/L	Date Collected	Date Received	Date In Oven	Date Out Oven
1	Ft. Detrick WWTP	EPA 160.2	TSS	5	BQL	10/26/92	10/26/92	11/02/92	11/03/92

BQL = "Below Quantitation Limit"

Note: Soil and solid waste samples are reported on a dry weight basis.

Client: University of MD-AES **Office:** Box 169 (Cheston Ln.) **Contact:** Dennis Burton **Phone:** (410)827-8056

Date: November 30, 1992 **Queenstown, MD 21658**

Project: Ft. Detrick WWTP

Matrix: Water

Lab #	Client ID	Reference Method	Parameter	Quantitation Limit mg/L	Concentration Detected mg/L	Date Collected	Date Received	Date Analyzed
1	Ft. Detrick WWTP	SM4500BrB	Bromide	0.1	BQL	10/26/92	10/26/92	11/13/92

BQL = "Below Quantitation Limit"

Note: Soil and solid waste samples are reported on a dry weight basis.

Client: University of MD-AES **Office:** Box 169 (Cheston Ln.) **Contact:** Dennis Burton **Phone:** (410)827-8056
Date: November 30, 1992 **Quantitation Limit** mg/L **Concentration** mg/L **Date** **Date**
Project: Ft. Detrick WWTP **mg/L** **mg/L** **Received** **Analyzed**

Matrix:	Water	Client ID	Reference Method	Parameter	Quantitation Limit mg/L	Concentration mg/L	Date Collected	Date Received	Date Analyzed
1	Ft. Detrick WWTP	EPA 353.2	Nitrate-N	0.05	5.67	10/26/92	10/26/92	11/02/92	

BQL = "Below Quantitation Limit"
Note: Soil and solid waste samples are reported on a dry weight basis.

Client: University of MD-AES

Date: November 30, 1992

Project: Ft. Detrick WWTP

Office: Box 169 (Cheston Ln.)
Queenstown, MD 21658

Contact: Dennis Burton

Phone: (410)827-8056

Matrix: Water

Lab # Client ID

Reference Method

Parameter

Quantitation Limit
mg/L

Sample Results
mg/L

Date Collected

Date Received

Date Extracted

Date Analyzed

1 Ft. Detrick
WWTP

Phosphate as Phosphorus

0.02

1.56

10/26/92

10/26/92

11/05/92

11/05/92

BQL = "Below Quantitation Limit"

Note: Soil and solid waste samples are reported on a dry weight basis.

Client: University of MD-AES

Date: November 30, 1992

Project: Ft. Detrick WWTP

Office: Box 169 (Cheston Ln.)
Queenstown, MD 21658

Contact: Dennis Burton

Phone: (410)827-8056

Matrix: Water

Lab #	Client ID	Reference Method	Parameter	Quantitation Limit mg/L	Concentration Detected mg/L	Date Collected	Date Received	Date Analyzed
1	Ft. Detrick WWTP	EPA 415.2	Total Organic Carbon	1	20	10/26/92	10/26/92	11/06/92

A9-11

BQL = "Below Quantitation Limit"

Note: Soil and solid waste samples are reported on a dry weight basis.

Client: University of MD-AES

Date: November 30, 1992

Project: Ft. Detrick WWTP

Office: Box 169 (Cheston Ln.)
Queenstown, MD 21658

Contact: Dennis Burton

Phone: (410)827-8056

Matrix: Water

Lab #	Client ID	Reference Method	Parameter	Quantitation Limit mg/L	Concentration Detected mg/L	Date Collected	Date Received	Date Analyzed
1	Ft. Detrick	EPA 350.1	Ammonia as Nitrogen	0.02	0.037	10/26/92	10/26/92	11/04/92

A9-12

BQL = "Below Quantitation Limit"

Note: Soil and solid waste samples are reported on a dry weight basis.

Client: University of MD-AES **Office:** Box 169 (Cheston Ln.) **Contact:** Dennis Burton **Phone:** (410)827-8056

Date: November 30, 1992 **Queenstown, MD 21658**

Project: Ft. Detrick WWTP

Matrix: Water

Lab #	Client ID	Reference Method	Parameter	Quantitation Limit mg/L	Concentration Detected mg/L	Date Collected	Date Received	Date Digested	Date Analyzed
1	Ft. Detrick WWTP	EPA 200.7	Aluminum	0.2	BQL	10/26/92	10/26/92	10/28/92	11/04/92
			Antimony	0.06	BQL				10/28/92
			Arsenic	0.1	BQL				11/03/92
			Beryllium	0.005	BQL				10/28/92
			Boron	0.05	0.16				11/06/92
			Cadmium	0.005	BQL				10/28/92
			Calcium	0.5	46.1				11/14/92
			Chromium	0.01	BQL				10/28/92
			Cobalt	0.04	BQL				10/28/92
			Copper	0.025	BQL				10/28/92
			Iron	0.1	0.12				11/04/92
			Lead	0.1	BQL				11/05/92
			Magnesium	0.5	9.31				11/04/92
			Manganese	0.015	BQL				10/28/92
			Molybdenum	0.04	BQL				11/06/92
			Nickel	0.04	BQL				10/28/92
			Potassium	0.1	7.34				11/05/92
			Selenium	0.1	BQL				11/03/92
			Silver	0.01	BQL				11/06/92
			Sodium	0.5	58.5				11/06/92
			Thallium	0.1	BQL				11/03/92
			Tin	0.1	BQL				11/05/92
			Zinc	0.05	BQL				10/28/92
		EPA 245.1	Mercury	0.0005	BQL			11/30/92	12/01/92

BQL = "Below Quantitation Limit"

Note: Soil and solid waste samples are reported on a dry weight basis.

Client: University of MD-AES **Office:** Box 169 (Cheston Ln.) **Contact:** Dennis Burton **Phone:** (410)827-8056

Date: November 30, 1992 **Queenstown, MD 21658**

Project: Ft. Detrick WWTP

Matrix: Water

Lab #	Client ID	Reference Method	Parameter	Quantitation Limit mg/L	Concentration Detected mg/L	Date Collected	Date Received	Date Analyzed
1	Ft. Detrick WWTP	EPA 376.1	Sulfide	1	13.2	10/26/92	10/26/92	10/27/92

BQL = "Below Quantitation Limit"

Note: Soil and solid waste samples are reported on a dry weight basis.

Client: University of MD-AES **Office:** Box 169 (Cheston Ln.) **Contact:** Dennis Burton **Phone:** (410)827-8056
Date: November 30, 1992 **Queenstown, MD 21658**
Project: Ft. Detrick WWTP

Matrix: Water

Lab #	Client ID	Reference Method	Parameter	Quantitation Limit MPN/100mL	Results MPN/100mL	Date Collected	Date Received	Date Started	Date Completed
1	Ft. Detrick WWTP	SM908C	Fecal Coliform	2	4	10/26/92	10/26/92	10/26/92	10/29/92

BQL = "Below Quantitation Limit"

Note: Soil and solid waste samples are reported on a dry weight basis.

Client: University of MD-AES **Office:** Box 169 (Cheston Ln.) **Contact:** Dennis Burton **Phone:** (410)827-8056
Date: November 30, 1992 **Queenstown, MD 21658**
Project: Ft. Detrick WWTP

Matrix	Water	Lab #	Client ID	Reference Method	Parameter	Quantitation Limit µg/L	Concentration Detected µg/L	Date Collected	Date Received	Date Distilled	Date Analyzed
1	Ft. Detrick WWTP	EPA 335.2	Cyanide	20	BQL	10/26/92	10/26/92	10/27/92	10/28/92		

BQL = "Below Quantitation Limit"
Note: Soil and solid waste samples are reported on a dry weight basis.

Client: University of MD-AES
Date: November 30, 1992
Project: Ft. Detrick WWTP

Office: Box 169 (Cheston Ln.)
Queenstown, MD 21658

Contact: Dennis Burton
Phone: (410)827-8056

Matrix: Water

Lab #	Client ID	Reference Method	Parameter	Concentration Detected mg/L	Date Collected	Date Received	Date Digested	Date Analyzed
1	Ft. Detrick WWTP	SM2540B	Hardness as CaCO ₃	153	10/26/92	10/26/92	10/28/92	11/04/92

A9-17

BQL = "Below Quantitation Limit"

Note: Soil and solid waste samples are reported on a dry weight basis.

Client: University of MD-AES **Office:** Box 169 (Cheston Ln.) **Contact:** Dennis Burton **Phone:** (410)827-8056
Date: November 30, 1992 **Queenstown, MD 21658**
Project: Ft. Detrick WWTP

Matrix: Water

Lab #	Client ID	Reference Method	Parameter	CAS #	Quantitation Limit $\mu\text{g/L}$	Concentration Detected $\mu\text{g/L}$	Date Collected	Date Received	Date Analyzed
1	Ft. Detrick WWTP	EPA 624	Acrolein	107-02-8	50	BQL	10/26/92	10/26/92	11/02/92
			Acrylonitrile	107-13-1	50	BQL			
			Benzene	71-43-2	5	BQL			
			Bromodichloromethane	75-27-4	5	10			
			Bromoform	75-25-2	5	BQL			
			Bromomethane	74-83-9	10	BQL			
			Carbon Tetrachloride	56-23-5	5	BQL			
			Chlorobenzene	106-90-7	5	BQL			
			Chloroethane	75-00-3	10	BQL			
			2-Chloroethyl vinyl ether	110-75-8	10	BQL			
			Chloroform	67-66-3	5	BQL			
			Chloromethane	74-87-3	10	BQL			
			Dibromochloromethane	124-48-1	5	6			
			1,2-Dichlorobenzene	95-50-1	5	BQL			
			1,3-Dichlorobenzene	541-73-1	5	BQL			
			1,4-Dichlorobenzene	106-46-7	5	BQL			
			1,1-Dichloroethane	75-34-3	5	BQL			
			1,2-Dichloroethane	107-06-2	5	BQL			
			1,1-Dichloroethene	75-35-4	5	BQL			
			trans-1,2-Dichloroethene	156-60-5	5	BQL			
			1,2-Dichloropropane	78-87-5	5	BQL			
			cis-1,3-Dichloropropene	10061-01-5	5	BQL			
			trans-1,3-Dichloropropene	10061-02-6	5	BQL			
			Ethylbenzene	100-41-4	5	BQL			
			Methylcyclohexane	75-09-2	5	BQL			
			1,1,2,2-Tetrachloroethane	79-34-5	5	BQL			
			Tetrachloroethene	127-18-4	5	BQL			
			Toluene	106-98-3	5	BQL			
			1,1,1-Trichloroethene	71-55-6	5	BQL			
			1,1,2-Trichloroethene	79-00-5	5	BQL			
			Trichloroethane	79-01-6	5	BQL			
			Trichlorofluoromethane	75-49-4	5	BQL			
			Vinyl Chloride	75-01-4	10	BQL			

* Sample 92102602-1 contained 31,000 $\mu\text{g/L}$ of Acetone.

BQL = "Below Quantitation Limit"

Note: Soil and solid waste samples are reported on a dry weight basis.

Client: University of MD-AES
Date: November 30, 1992
Project: Ft. Detrick WWTP

Office: Box 169 (Cheston Ln.)
 Queenstown, MD 21658

Contact: Dennis Burton
Phone: (410)827-8056

Matrix: Water

Lab #	Client ID	Reference Method	Parameter	Quantitation Limit µg/L	Concentration Detected µg/L	Date Collected	Date Received	Date Extracted	Date Analyzed
1	Ft. Detrick WWTP	EPA 615	2,4D	0.1	BQL	10/26/92	10/26/92	11/03/92	11/08/92
			Silvex	0.1	BQL				
			2,4,5T	0.1	BQL				
			Dicamba	0.1	BQL				

A9-19

BQL = "Below Quantitation Limit"

Note: Soil and solid waste samples are reported on a dry weight basis.

Client: University of MD-AES
 Date: November 30, 1992
 Project: FL Detrick WWTP

Office: Box 169 (Cheston Ln.)
 Queenstown, MD 21658

Contact: Dennis Burton
 Phone: (410)827-8056

Matrix	Water	Client ID #:	FL Detrick WWTP	Lab ID #:	1	Method:	625
Date Collected:	10/26/92	Date Received:	10/26/92	Date Extracted:	10/29/92	Date Analyzed:	10/29/92
Parameter	CAS #	Quantitation Limit $\mu\text{g/L}$	Analytical Results $\mu\text{g/L}$	Parameter	CAS #	Quantitation Limit $\mu\text{g/L}$	Analytical Results $\mu\text{g/L}$
N-Nitrosodimethylamine	62-75-9	10	BQL	Acenaphthene	83-32-9	10	BQL
Phenol	108-95-2	10	BQL	2,4-Dinitrophenol	51-28-5	50	BQL
bis-(2-Chloroethyl)Ether	111-44-4	10	BQL	4-Nitrophenol	100-02-7	50	BQL
2-Chlorophenol	95-57-8	10	BQL	1,3-Dichlorobenzene	541-73-1	10	BQL
2,6-Dinitrotoluene	606-20-2	10	BQL	1,4-Dichlorobenzene	106-46-7	10	BQL
2,4-Dinitrotoluene	121-14-2	10	BQL	Dichlorophthalate	84-66-2	10	BQL
1,2-Dichlorobenzene	95-50-1	10	BQL	4-Chlorophenyl-phenylether	7005-72-3	10	BQL
Phenol	86-73-7	10	BQL	4,6-Dinitro-2-methylphenol	534-52-1	50	BQL
N-Nitroso-Di-n-propylamine	621-64-7	10	BQL	N-Nitrosodiphenylamine	86-30-6	10	BQL
Hexachlorobenzene	67-72-1	10	BQL	Nitrobenzene	98-95-3	10	BQL
4-Bromophenyl-phenylether	101-55-3	10	BQL	Isophorone	78-59-1	10	BQL
Hexachlorobenzene	118-74-1	10	BQL	2-Nitrophenol	88-75-3	10	BQL
Pentachlorophenol	87-86-5	50	BQL	2,4-Dimethylphenol	105-67-9	10	BQL
Phenanthrene	83-01-8	10	BQL	Anthrone	120-12-7	10	BQL
bis-(2-Chloroethyl)Methane	111-91-1	10	BQL	Di-n-Butylphthalate	84-74-2	10	BQL
2,4-Dichlorophenol	120-83-2	10	BQL	Fluoranthene	206-44-0	10	BQL
1,2,4-Trichlorobenzene	120-82-1	10	BQL	Benzidine	92-87-9	50	BQL
Naphthalene	91-20-3	10	BQL	Pyrene	129-00-0	10	BQL
4-Chloronitrobenzene	106-47-8	10	BQL	Butylbenzophthalate	85-48-7	10	BQL
Hexachlorobutadiene	87-48-3	10	BQL	3,3'-Dichlorobenzidine	91-94-1	20	BQL
4-Chloro-3-methylphenol	59-50-7	10	BQL	Benzof(a)Anthracene	56-55-3	10	BQL
bis-(2-Ethylhexyl)Phthalate	117-81-7	10	BQL	Chrysene	218-01-9	10	BQL
2,4,6-Trichlorophenol	88-06-2	10	BQL	Di-n-octyl phthalate	117-84-0	10	BQL
Benzof(b)fluoranthene	205-99-2	10	BQL	2-Chloronaphthalene	91-58-7	10	BQL
Benzof(k)fluoranthene	207-08-9	10	BQL	Benzof(a)Pyrene	50-32-8	10	BQL
Dibenzyl Phthalate	131-11-3	10	BQL	Iodeno(1,2,3-cd)Pyrene	193-39-5	10	BQL
Acenaphthylene	208-96-8	10	BQL	Dibenzof(a,h)Anthracene	53-70-3	10	BQL
Benzof(a,h)Pyrene	191-24-2	10	BQL				

BQL = "Below Quantitation Limit"

Note: Soil and solid waste samples are reported on a dry weight basis.

Client: University of MD-AES **Office:** Box 169 (Cheston Ln.) **Contact:** Dennis Burton **Phone:** (410)827-8056
Date: November 30, 1992 **Queenstown, MD 21658**
Project: Ft. Detrick WWTP

Matrix	Lab #	Client ID	Reference Method	Parameter	Quantitation Limit $\mu\text{g/L}$	Concentration Detected $\mu\text{g/L}$	Date Collected	Date Received	Date Extracted	Date Analyzed
Water	1	Ft. Detrick	EPA 608 WWTP	e-BHC	0.02	BQL	10/26/92	10/26/92	10/28/92	11/08/92
				β -BHC	0.02	BQL				
				Lindane	0.02	BQL				
				δ -BHC	0.02	BQL				
				Heptachlor	0.02	BQL				
				Aldrin	0.02	BQL				
				Hept. Epoxide	0.02	BQL				
				Endosulfan I	0.02	BQL				
				p,p'-DDE	0.02	BQL				
				Dieldrin	0.02	BQL				
				Endosulfan SO_4	0.02	BQL				
				p,p'-DDD	0.02	BQL				
				Endrin	0.02	BQL				
				Endrin Ald.	0.02	BQL				
				Endosulfan II	0.02	BQL				
				p,p'-DDT	0.02	BQL				
				Endrin Ketone	0.02	BQL				
				Methoxychlor	0.02	BQL				
				Chlordane	0.16	BQL				
				Toxaphene	1.0	BQL				
				Aroclor-1016	0.2	BQL				
				Aroclor-1221	0.2	BQL				
				Aroclor-1232	0.2	BQL				
				Aroclor-1242	0.2	BQL				
				Aroclor-1248	0.2	BQL				
				Aroclor-1254	0.2	BQL				
				Aroclor-1260	0.2	BQL				

A9-21

BQL = "Below Quantitation Limit"

Note: Soil and solid waste samples are reported on a dry weight basis.

Client: University of MD-AES

Date: November 30, 1992

Project: Ft. Detrick WWTP

Office: Box 169 (Cheston Ln.)

Queenstown, MD 21658

Contact: Dennis Burton

Phone: (410)827-8056

Matrix: Water

Lab #	Client ID	Reference Method	Parameter	Quantitation Limit µg/L	Concentration Detected µg/L	Date Collected	Date Received	Date Extracted	Date Analyzed
1	Ft. Detrick WWTP	EPA 614	Azinophos Methyl	0.08	BQL	10/26/92	10/26/92	11/02/92	11/24/92
			Demeton	0.08	BQL				
			Diazinon	0.08	BQL				
			Disulfeton	0.08	BQL				
			Malathion	0.08	BQL				
			Ethyl Parathion	0.08	BQL				
			Methyl Parathion	0.08	BQL				

A9-22

BQL = "Below Quantitation Limit"

Note: Soil and solid waste samples are reported on a dry weight basis.

Client: University of MD-AES
Date: November 30, 1992
Project: Ft. Detrick WWTP

Office: Box 169 (Cheston Ln.)
 Queenstown, MD 21658

Contact: Dennis Burton
Phone: (410)827-8056

Client ID:	Ft. Detrick WWTP	Date Collected:	10/26/92	Date Received:	10/26/92	Date Expected:	10/28/92
Matrix:	Drinking Water	Lab #:	1	Reference Method:	507	Date Analyzed:	11/06/92
Parameter	CAS #	Quantitation Limit µg/L	Analytical Results µg/L	Parameter	CAS #	Quantitation Limit µg/L	Analytical Results µg/L
Alachlor	15972-60-8	5	BQL	Ametryn	834-12-8	5	BQL
Atrazine	1610-17-9	5	BQL	Atrazine	1912-24-9	5	BQL
Bromacil	314-40-9	5	BQL	Butachlor	23184-66-9	5	BQL
Burfylate	2008-41-5	5	BQL	Carbozin	5234-68-5	5	BQL
Chlorpropham	101-21-3	5	BQL	Cycloate	1134-23-2	5	BQL
Diazinon(a)	333-41-5	5	BQL	Dichlorvos	62-73-7	5	BQL
Dibenzofuran	957-51-7	5	BQL	Dialufoson	298-04-4	5	BQL
Dibenzofuran sulfone	2497-06-5	5	BQL	EPTC	759-94-4	5	BQL
Ethion	13194-48-4	5	BQL	Fenamiphos	22224-92-6	5	BQL
Fenarimol	60168-88-9	5	BQL	Fluridone	59756-60-4	5	BQL
Hexachlor	51233-04-2	5	BQL	Merphos	150-50-5	5	BQL
Mesochlor	51218-45-2	5	BQL	Metribuzin	21087-64-9	5	BQL
Mevinphos	7786-34-7	5	BQL	MGK 264	113-48-4	5	BQL
Molinate	2212-674-1	5	BQL	Napropamide	15299-99-7	5	BQL
Norfurazon	27314-13-2	5	BQL	Pebulate	1114-71-2	5	BQL
Prometon	1610-18-0	5	BQL	Proxactrin	7287-19-6	5	BQL
Prometazone(a)	23950-58-5	5	BQL	Propazine	139-40-2	5	BQL
Sinazinc	122-34-9	5	BQL	Siametyn	1014-70-6	5	BQL
Sintron	22248-79-9	5	BQL	Tebufluoro	34014-18-1	5	BQL
Terbacil	5902-51-2	5	BQL	Terbufos(a)	13071-79-9	5	BQL
Terbutryn	886-50-0	5	BQL	Triadimenol	43121-43-3	5	BQL
Thiophanate	41814-78-2	5	BQL	Vernolate	1929-77-7	5	BQL

BQL = "Below Quantitation Limit"
 Note: Soil and solid waste samples are reported on a dry weight basis.

Client: University of MD-AES
 Date: November 30, 1992
 Project: Ft. Detrick WWTP

Office: Box 169 (Cheston Ln.)
 Queenstown, MD 21658

Contact: Dennis Burton
 Phone: (410)827-8056

MISCELLANEOUS QC DATA

<u>INITIALS</u>	<u>PARAMETER</u>	<u>BLANK</u>	<u>MATRIX SPIKE</u>	<u>MATRIX SPIKE %RECOVERY</u>	<u>LCS T.V.</u>	<u>LCS %RECOVERY</u>
DP	Chloride	<1 mg/L	NA	NA	67.50 mg/L	66.67
JPL	Alkalinity	<5 mg/L	NA	NA	216 mg/L	108
JPL	Fluoride	<0.1 mg/L	0.4 mg/L	93	6.9 mg/L	100
IH	Conductivity	0.65 μ mho/cm	NA	NA	1359 μ mho/cm	97
JPL/ACC	TSS	<5 mg/L	NA	NA	NA	NA
RG	Bromide	0.1 mg/L	NA	NA	NA	NA
JP	Nitrate-N	<0.05 mg/L	0.1 mg/L	105	0.6 mg/L	103
JPL	Phosphorous	<0.02 mg/L	0.196 mg/L	82	3.93 mg/L	100
JS	TOC	<1 mg/L	2.0 mg/L	100	102.26 mg/L	104
JPL	Ammonia	<0.02 mg/L	0.2 mg/L	113	0.47 mg/L	109
JPL	Sulfide	<1 mg/L	NA	NA	NA	NA
IH	Fecal Colliform	NA	NA	NA	NA	NA
JPL	Cyanide	<20 μ g/L	250 μ g/L	100	500 μ g/L	103
MC	Hardness	NA	NA	NA	NA	NA

A9-24

BQL - "Below Quantitation Limit"

Note: Soil and solid waste samples are reported on a dry weight basis.

Client: University of MD-AES
Date: November 30, 1992
Project: Ft. Detrick WWTP

Office: Box 169 (Cheston Ln.)
 Queenstown, MD 21658

Contact: Dennis Burton
Phone: (410)827-8056

Initials	Parameter	Blank	608 QC DATA			
			Matrix Spike T.V.	Matrix Spike %Recovery	Matrix Spike Dup %Recovery	LCS T.V.
CN	Lindane	<0.02 µg/L	0.32 µg/L	67	67	0.32
	Heptachlor	<0.02 µg/L	0.32 µg/L	86	86	0.32
	Aldrin	<0.02 µg/L	0.32 µg/L	76	76	0.32
	Dieldrin	<0.02 µg/L	0.8 µg/L	80	77	0.8
	Endrin	<0.02 µg/L	0.8 µg/L	82	79	0.8
	DDT	<0.02 µg/L	0.8 µg/L	110	100	0.8
						LCS %Recovery
						64
						81
						71
						73
						70
						110

BQL = "Below Quantitation Limit"
Note: Soil and solid waste samples are reported on a dry weight basis.

Client: University of MD-AES
Date: November 30, 1992
Project: Ft. Detrick WWTP

Office: Box 169 (Cheston Ln.)
 Queenstown, MD 21658

Contact: Dennis Burton
Phone: (410)827-8056

615 QC DATA

<u>Initials</u>	<u>Parameter</u>	<u>Blank</u>	<u>Matrix Spike T.V.</u>	<u>Matrix Spike %Recovery</u>	<u>Matrix Spike Dup %Recovery</u>	<u>LCS T.V.</u>	<u>LCS %Recovery</u>
AWM	2,4 D	<0.1 µg/L	1 µg/L	120	140	1 µg/L	83
↓	Silica(2,4,5,TP)	<0.1 µg/L	1 µg/L	110	110	1 µg/L	98
	2,4,5 T	<0.1 µg/L	1 µg/L	180	180	1 µg/L	110

BQL = "Below Quantitation Limit"

Note: Soil and solid waste samples are reported on a dry weight basis.

Client: University of MD-AES **Office:** Box 169 (Cheston Ln.) **Contact:** Dennis Burton **Phone:** (410)827-8056
Date: November 30, 1992 **Queenstown, MD 21658**
Project: Ft. Detrick WWTP

624 QC DATA

<u>Initials</u>	<u>Parameter</u>	<u>Blank</u>	<u>Matrix Spike T.V.</u>	<u>Matrix Spike %Recovery</u>	<u>Matrix Spike Dup %Recovery</u>	<u>LCS T.V.</u>	<u>LCS %Recovery</u>
TV →	1,1-Dichloroethene	<10.00 µg/L	50.00 µg/L	94	95	50.00 µg/L	84
	Trichloroethene	<10.00 µg/L	50.00 µg/L	90	92	50.00 µg/L	84.99
	Benzene	<10.00 µg/L	50.00 µg/L	99	100	50.00 µg/L	93.72
	Toluene	<10.00 µg/L	50.00 µg/L	400	104.61	50.00 µg/L	96.33
	Chlorobenzene	<10.00 µg/L	50.00 µg/L	92	95	50.00 µg/L	88.53
	1,2-Dichloroethane-d4	<10.00 µg/L	50.00 µg/L	NA	104.59	NA	NA
	Bromofluorobenzene	<10.00 µg/L	50.00 µg/L	NA	85.46	NA	NA

BQL = "Below Quantitation Limit"

Note: Soil and solid waste samples are reported on a dry weight basis.

Client: University of MD-AES
 Date: November 30, 1992
 Project: Ft. Detrick WWTP

Office: Box 169 (Cheston Ln.)
 Queenstown, MD 21658

Contact: Dennis Burton
 Phone: (410)827-8056

§25 QC DATA						
Initials	Parameter	Blank	Matrix Spike T.V.	Matrix Spike %Recovery	Matrix Spike Dup %Recovery	LCS T.V. LCS %Recovery
PM	2-Fluorophenol	<10.00 µg/L	100.00 µg/L	87.13	NA	100.00 µg/L 95.49
	Phenol-d5	<10.00 µg/L	100.00 µg/L	68.41	NA	100.00 µg/L 65.60
	Nitrobenzene-d5	<10.00 µg/L	50.00 µg/L	136.57	NA	50.00 µg/L 151.41
	2-Fluorobiphenol	<10.00 µg/L	50.00 µg/L	132.03	NA	50.00 µg/L 141.64
	2,4,6-Tribromophenol	<10.00 µg/L	100.00 µg/L	142.49	NA	100.00 µg/L 141.00
	p-Terphenol	<10.00 µg/L	50.00 µg/L	127.44	NA	50.00 µg/L 110.30

BQL = "Below Quantitation Limit"

Note: Soil and solid waste samples are reported on a dry weight basis.

Client: University of MD-AES
 Date: November 30, 1992
 Project: Ft. Detrick WWTP

Office: Box 169 (Cheston Ln.)
 Queenstown, MD 21658

Contact: Dennis Burton
 Phone: (410)827-8056

614 QC DATA

<u>Initials</u>	<u>Parameter</u>	<u>Blank</u>	<u>Matrix Spike T.V.</u>	<u>Matrix Spike % Recovery</u>	<u>Matrix Spike Dup % Recovery</u>	<u>LCS T.V.</u>	<u>LCS % Recovery</u>
C.N.	Diazinon	<0.08 µg/L	0.8 µg/L	110	130	0.8 µg/L	112
↓	Round	<0.08 µg/L	0.8 µg/L	100	140	0.8 µg/L	107
	Coumaphos	<0.08 µg/L	0.8 µg/L	77	128	0.8 µg/L	92

BQL = "Below Quantitation Limit"

Note: Soil and solid waste samples are reported on a dry weight basis.

Client: University of MD-AES

Date: November 30, 1992

Project: Ft. Detrick WWTP

Office: Box 169 (Cheston Ln.)
Queenstown, MD 21658

Contact: Dennis Burton

Phone: (410)827-8056

507 QC DATA

Initials	Parameter	Blank	Matrix Spike T.V.	Matrix Spike %Recovery	Matrix Spike Dup %Recovery	LCS T.V.	LCS %Recovery
AJD	Molinate	<1 µg/L	1 µg/L	64	NA	1 µg/L	63
	Atrazine	<1 µg/L	1 µg/L	66	NA	1 µg/L	63
	Alachlor	<1 µg/L	1 µg/L	61	NA	1 µg/L	60
	Nitrotylene	<1 µg/L	1 µg/L	76	NA	1 µg/L	74

BQL = "Below Quantitation Limit"

Note: Soil and solid waste samples are reported on a dry weight basis.

MS data file header from : >CF229::04

Sample: 920102602-1 WWTP Operator: JOE MS 10/29/92 20:18
isc : Ft. Detrick DF0729, GC/MS# 3 BTL# 3
sys. #: 2 MS model: 70 SW/HW rev.: LF ALS #: 3 Equip ID: GC/MS#2
Method file: METBNA Tuning file: DF0929 No. of extra records: 2
Source temp.: N/A Analyzer temp.: N/A Transfer line temp.: 0

Chromatographic temperatures : 35. 290. 0. 0. 0.
Chromatographic times, min. : 3.0 25.0 0.0 0.0 0.0
Chromatographic rate, deg/min: 10.0 0.0 0.0 0.0 0.0

>CF229 920102602-1 WWTP Ft. Detrick DF0729, GC/MS# 3
35.01 450.0 CLP TIC

Upslope: .2000 Area Reject: 10467. Max Peaks: 12 Bunch: -1 Valley >100 %
Dnslope: 0.0000 Results File ICF229 Sorted by Time/Area INT

Peak #	R.T. min.	first scan	max scan	last scan	peak height	raw area	corr. area	corr. % max.	% of total
1	16.67	643	647	652	40601	97882	95654	55.59	10.60
2	19.11	772	782	787	71165	173586	172072	100.00	19.11
3	21.28	898	902	907	51903	131295	130934	76.09	14.50
4	23.16	1002	1006	1010	38863	99377	96692	56.19	10.77
5	24.83	1088	1098	1101	30031	72725	71568	41.59	7.90
6	26.35	1177	1182	1187	23051	62339	60602	35.22	6.75
7	29.00	1325	1329	1337	18937	59080	52539	30.53	5.86
8	30.40	1402	1406	1408	13607	28268	25399	14.76	2.80
9	32.08	1492	1499	1508	8753	43139	36905	21.45	4.11
10	34.18	1609	1615	1625	4892	33549	25040	14.55	2.79
11	34.18	2121	2127	2137	4892	33549	25040	14.55	2.79
12	37.21	2283	2295	2318	9461	118834	104666	60.83	11.66

Sum of corrected areas: 897111.

Summary of Unknowns PBM Library Search and Quantitation

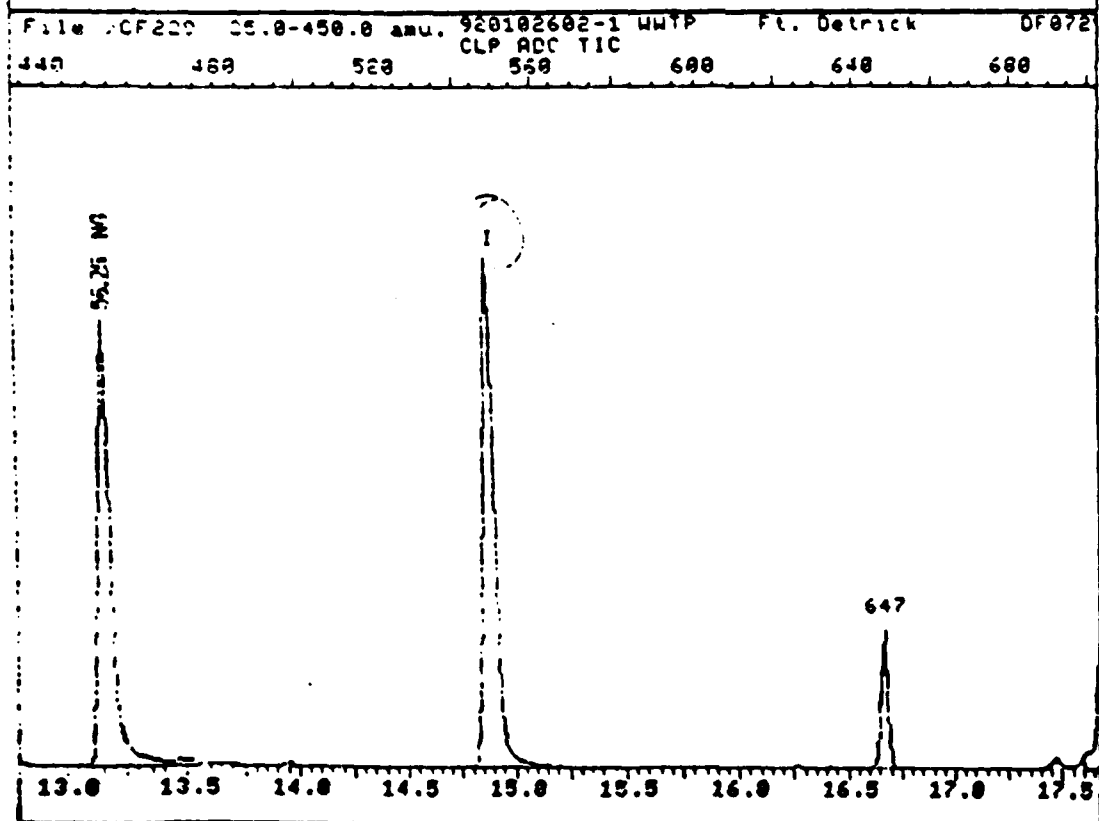
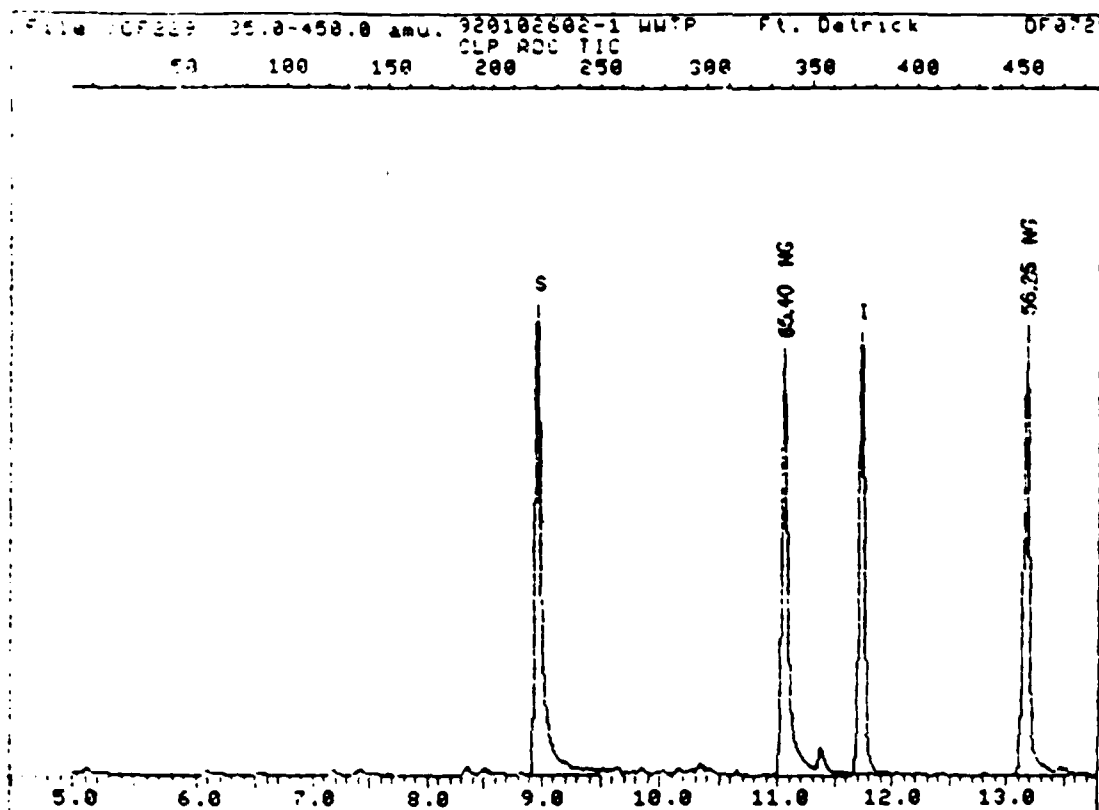
Standard	Concentration	Area	Retention Time	Unknown Window
1	40.0	432483.	11.72	4.99 - 13.30
2	40.0	531200.	14.88	13.30 - 17.18
3	40.0	559782.	19.47	17.18 - 21.40
4	40.0	452311.	23.33	21.40 - 26.93
5	40.0	187450.	30.54	26.93 - 33.88
6	40.0	104666.	37.21	33.88 - 38.17

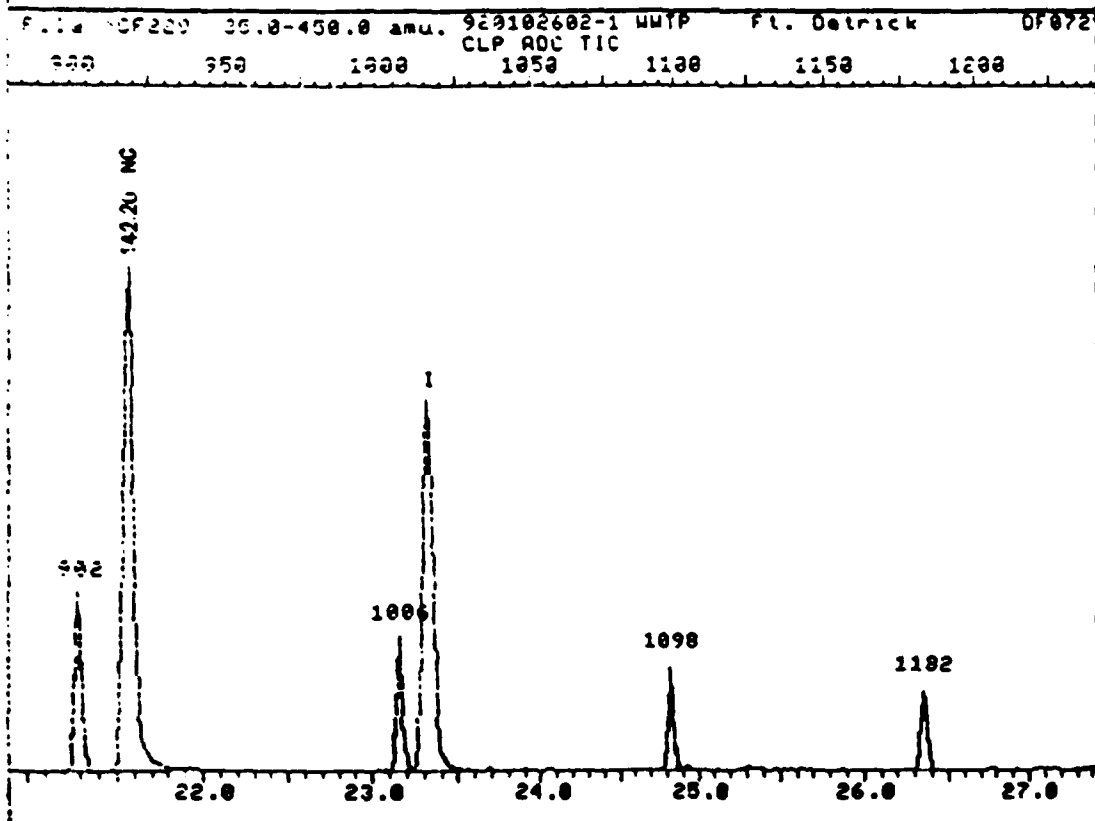
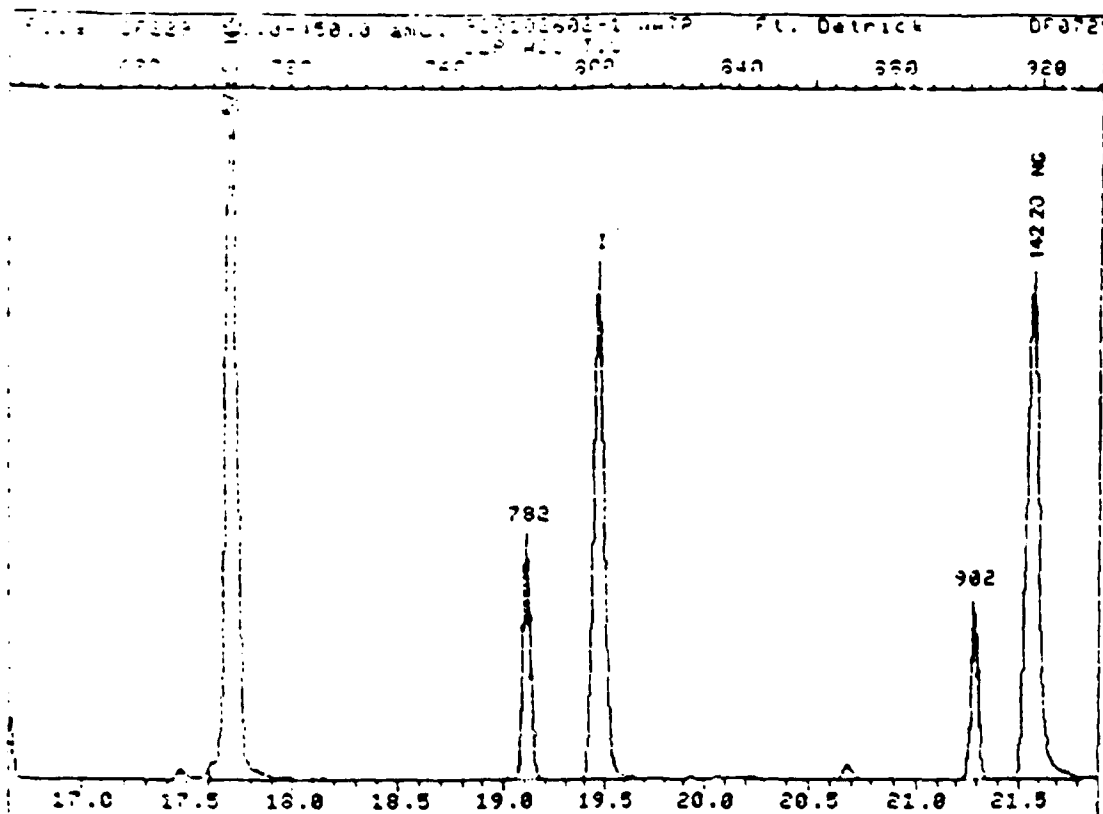
Dilution Factor = 1.00

This sample was 1000.00 g or mL

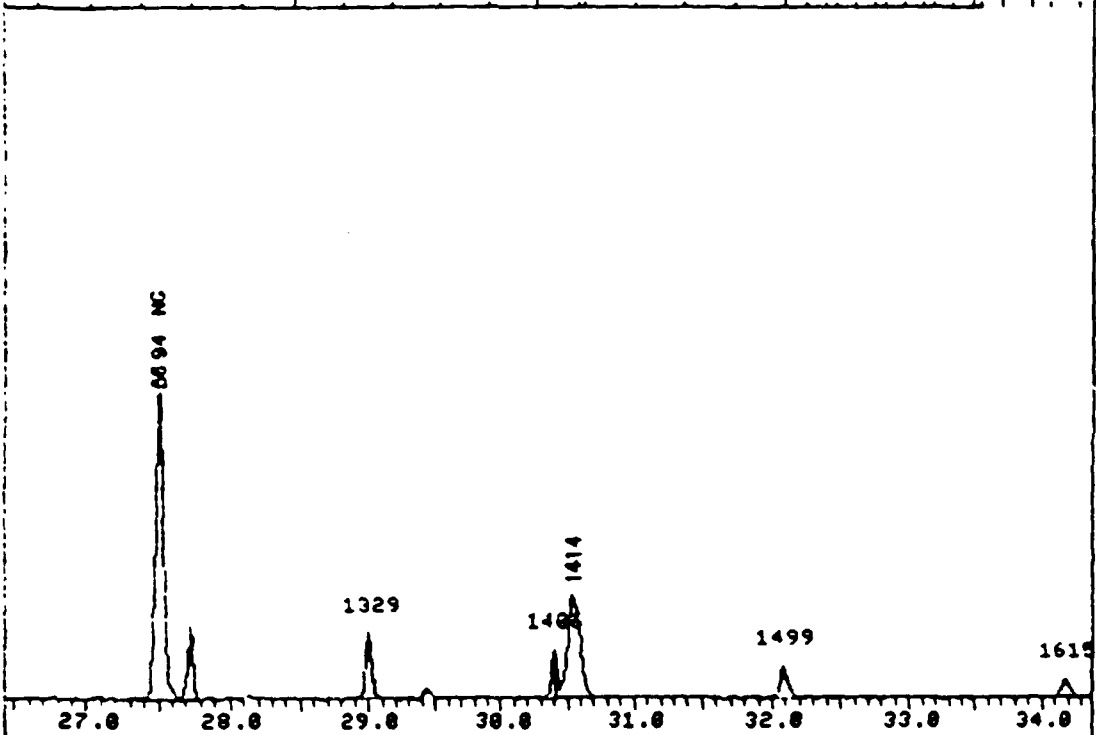
Correction Factor = 1.00

12:32 PM DEC., 25 NOV., 1992

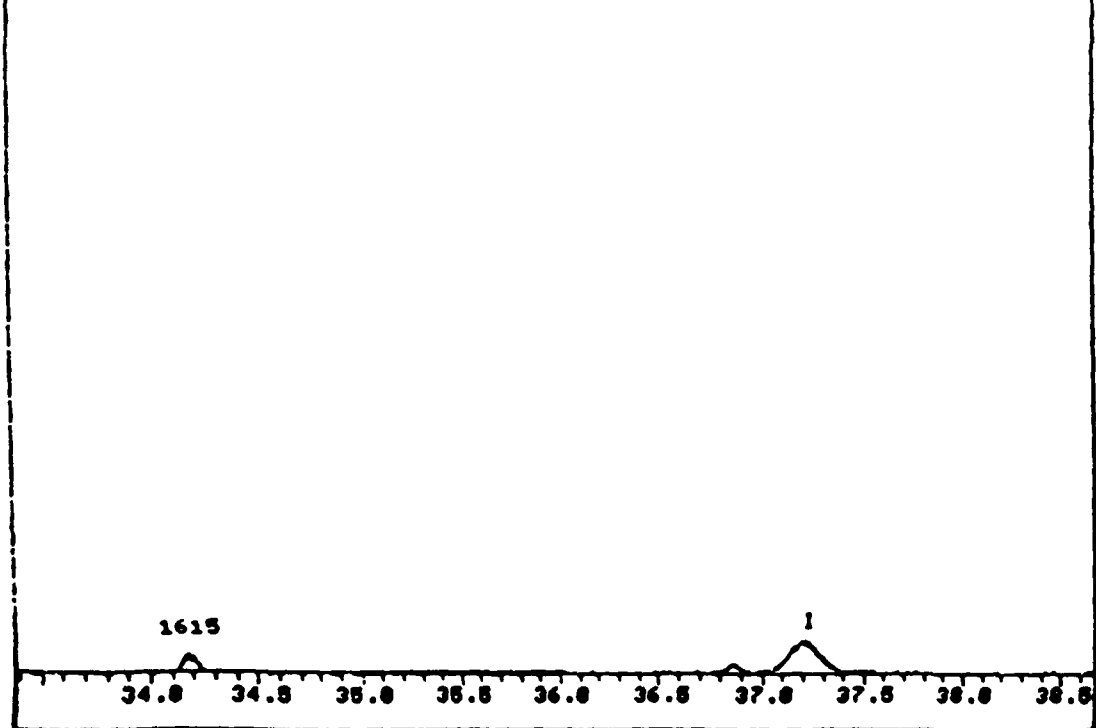


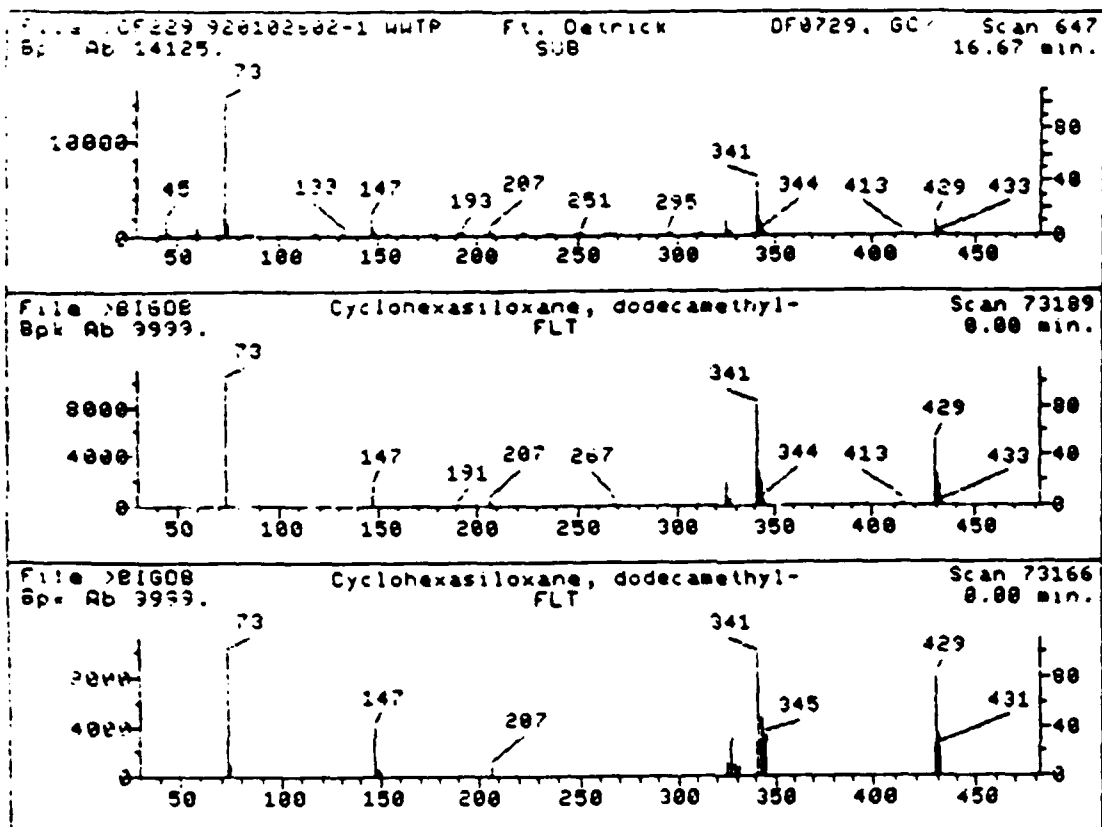


File >CF229 35.0-450.0 amu. 920102602-1 MWTP Ft. Detrick DF072
 CLP ADC TIC 1200 1400 26001600



File >CF229 35.0-450.0 amu. 920102602-1 MWTP Ft. Detrick DF072
 CLP ADC TIC 2065





Instrument ID: GC/MS# Analyzed on: 10/29/92 20:18
Result 1 in PBM results file: LCF229
Retention Time: 16.67 Area: 95654 Tentative Conc:
The unknown area is 18.01% of the nearest internal standard

7.00

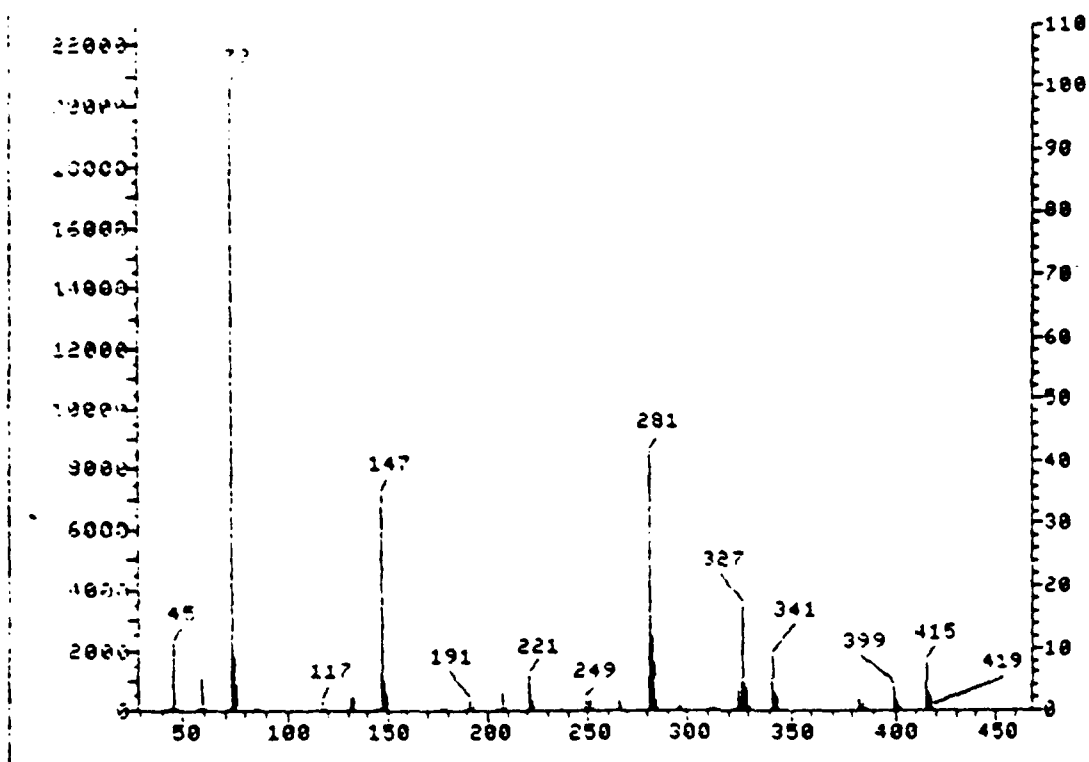
1. Cyclohexasiloxane, dodecamethyl-
2. Cyclohexasiloxane, dodecamethyl-

444 C12H36O6Si6
444 C12H36O6Si6

Sample file: >CF229 Spectrum #: 647
Search speed: 1 Tilting option: N No. of ion ranges searched: 45

	Prob.	CAS #	CON #	ROOT	K	DK	#FLG	TILT	%	CON	C_I	R_IC
1.	54	540976	73139	"B1608	89	69	2	0	49	23	22	26
2.	15	540976	73166	"B1608	45	49	1	0	11	56	3	14

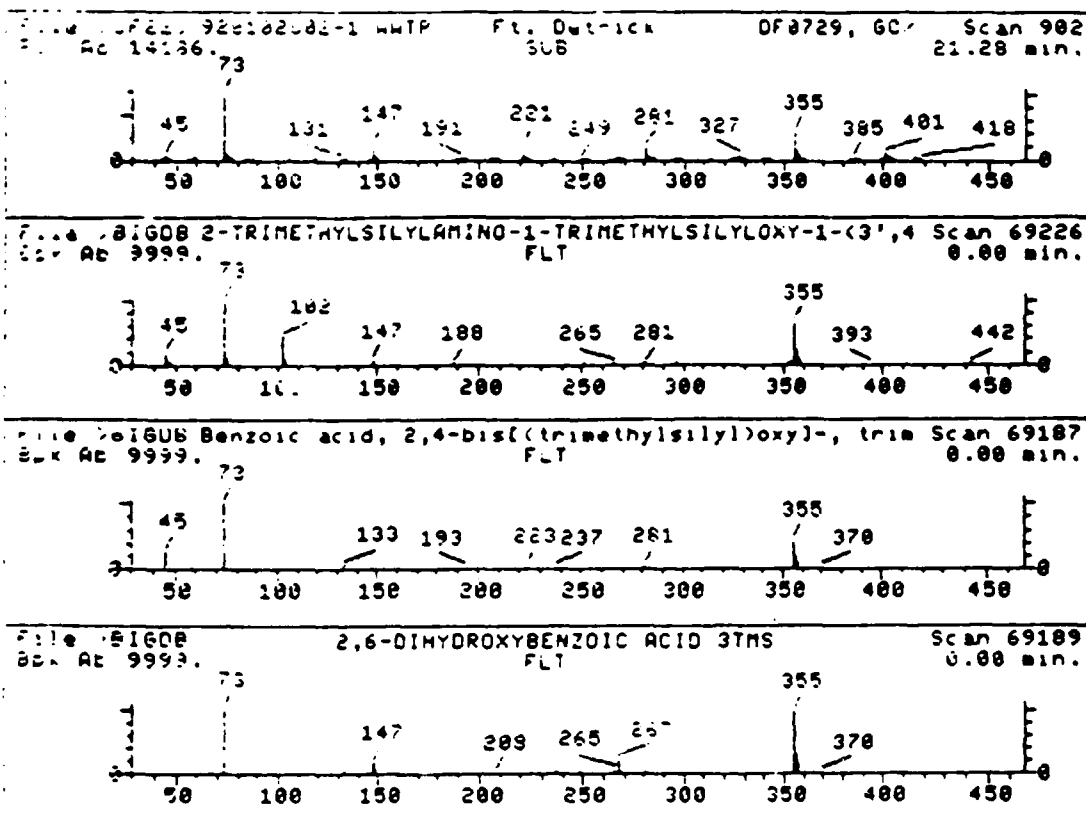
File: LCF229 920102002-1 WHTP Ft. Detrick GC/MS Scan 782
 65 At 20616. SUB 19.11 min.



Instrument ID: GC/MS# Analyzed on: 10/29/92 20:18
 Result 2 in PBM results file: LCF229
 Retention Time: 19.11 Area: 172072 Tentative Conc: 12.00
 The unknown area is 30.74% of the nearest internal standard

Sample file: >CF229 Spectrum #: 782

No data base entries were retrieved.



Instrument ID: GC/MS# Analyzed on: 10/29/92 20:18
 Result 3 in PBM results file: LCF229
 Retention Time: 21.28 Area: 130934 Tentative Conc:
 The unknown area is 23.39% of the nearest internal standard

9.00

- 2-TRIMETHYLSILYLAMINO-1-TRIMETHYLSILOXY-1-(3',4'-B 457 C20H43NO3Si4
 IS(1-TRIMETHYLSILOXY)-PHENYLETHANE
- Benzoic acid, 2,4-bis[(trimethylsilyl)oxy]-, trimeth 370 C16H30O4Si3
 ylsilyl ester
- 2,6-DIHYDROXYBENZOIC ACID 3TMS 370 C16H30O4Si3
- Benzeneacetic acid, .alpha.,3,4-tris[(trimethylsilyl 472 C20H40O5Si4
)oxyl-, trimethylsilyl ester
- Benzoic acid, 2,5-bis[(trimethylsiloxy)-, trimethyls 370 C16H30O4Si3
 yl ester
- Benzeneacetic acid, .alpha.,3,4-tris[(trimethylsilyl 472 C20H40O5Si4
)oxyl-, trimethylsilyl ester

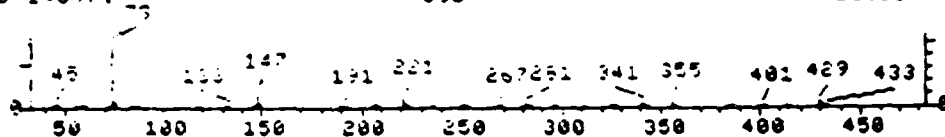
Sample file: LCF229 Spectrum #: 902
 Search speed: 1 Tilting option: N No. of ion ranges searched: 43

Prob.	CAS #	CON #	ROOT	K	DK	#FLG	TILT	%	CON	C_I	R_IV	
1.	70*	0	69226	"81608	81	81	1	0	52	43	24	77
2.	81608	1	69187	"81608	70	71	0	0	93	10	01	52

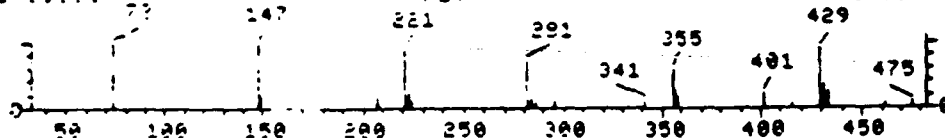
10.70

6.	30	37148655	69229	"BIGDB	73	76	2	0	91	43	8	18
----	----	----------	-------	--------	----	----	---	---	----	----	---	----

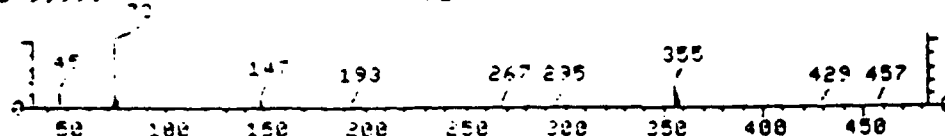
File: CF229 920102022-1 JHTP Ft. Detrick DF0729, 6C/ Scan 1006
 60% Ab 14697. 23.16 min.



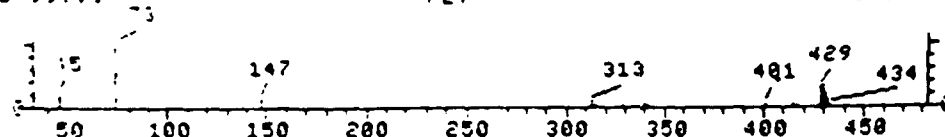
File: 73184 OCTADECAMETHYLCYCLONONASILOXANE Scan 73184
 60% Ab 9999. FLT 0.00 min.



File: 69351 Benzeneacetic acid, .alpha.,3,4-tris(trimethylsilyl) Scan 69351
 60% Ab 9999. FLT 0.00 min.



File: 73246 2H-1,4-Benzodiazepin-2-one, 7-chloro-1,3-dihydro- Scan 73246
 60% Ab 9999. FLT 0.00 min.



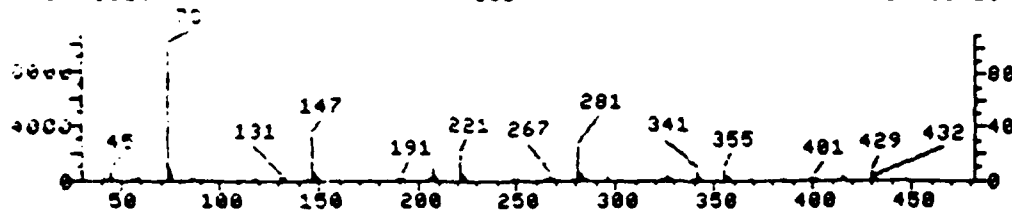
Instrument ID: GC/MS# Analyzed on: 10/29/92 20:18
 Result 4 in PBM results file: LCF229
 Retention Time: 23.16 Area: 96692 Tentative Conc: 9.00
 The unknown area is 21.38% of the nearest internal standard

1. OCTADECAMETHYLCYCLONONASILOXANE 666 C18H54O9Si9
2. Benzeneacetic acid, .alpha.,3,4-tris(trimethylsilyl) 472 C20H40O5Si4
)oxy)-, trimethylsilyl ester
3. 2H-1,4-Benzodiazepin-2-one, 7-chloro-1,3-dihydro-5-p 430 C21H27ClN2O2Si
 henyl-1-(trimethylsilyl)-3-[(trimethylsilyl)oxy]- 2

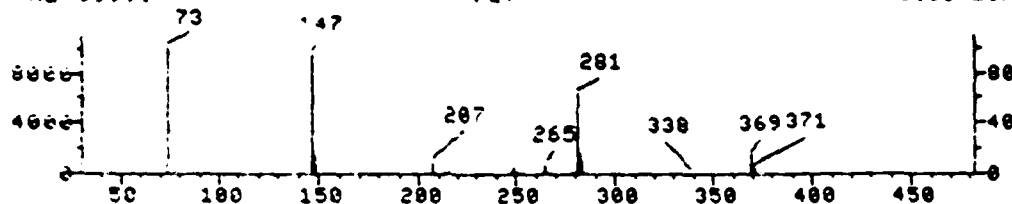
Sample file: >CF229 Spectrum #: 1006
 Search speed: 1 Tilting option: N No. of ion ranges searched: 72

	Prob.	CAS #	CON #	ROOT	K	DK	#FLG	TILT	%	CON	C_I	R_IV
1.	35	556718	73184	"BIGOB	79	78	1	0	10	50	11	31
2.	27	37148655	69351	"BIGOB	26	80	0	0	18	50	7	18
3.	17	55319932	73246	"BIGOB	61	90	1	0	13	62	4	57

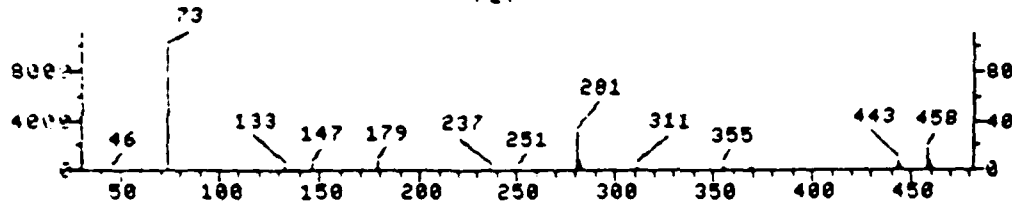
File: >CF229 92010202-1 WHTP Ft. Detrick DF0729, GC/ Scan 1098
 20: Ab 9652. SUB 24.83 min.



File: >S1608 Trisiloxane, 1,1,1,5,5,5-hexamethyl-3,3-bis(trimethylsiloxy)-, trime Scan 61753
 20: Ab 9993. FLT 0.00 min.



File: >S1609 Benzoic acid, 3,4,5-tris(trimethylsiloxy)-, trime Scan 74086
 20: Ab 9993. FLT 0.00 min.

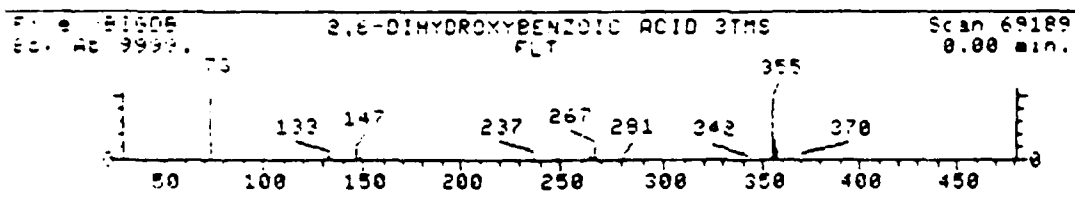


Instrument ID: GC/MS# Analyzed on: 10/29/92 20:18
 Result 5 in PBM results file: LCF229
 Retention Time: 24.83 Area: 71568 Tentative Conc: 6.00
 The unknown area is 15.82% of the nearest internal standard

- * 1. Trisiloxane, 1,1,1,5,5,5-hexamethyl-3,3-bis(trimethylsilyloxy)- 384 C12H36O4Si5
- 2. Benzoic acid, 3,4,5-tris(trimethylsiloxy)-, trimethylsilyl ester 458 C19H38O5Si4

Sample file: >CF229 Spectrum #: 1098
 Search speed: 1 Tilting option: N No. of ion ranges searched: 71

	Prob.	CAS #	CON #	ROOT	K	DK	#FLG	TILT	%	CON	C_I	R_I
1.	28	3555473	61753	"BIGDB	78	58	1	0	35	55	8	30
2.	20	2078173	74086	"BIGDB	53	110	1	0	80	55	5	12



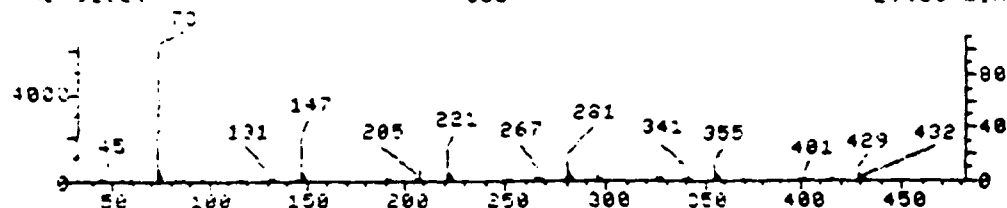
Instrument ID: GC/MS# Analyzed on: 10/29/92 20:18
Result 6 in FBM results file: LCF229
Retention Time: 26.35 Area: 60602 Tentative Conc: 5.00
The unknown area is 13.40% of the nearest internal standard

- | | | | |
|------|---|-----|--------------|
| 1. | Benzeneacetic acid, .alpha.,3,4-tris[(trimethylsilyl)oxy]-, trimethylsilyl ester | 472 | C20H40O5Si4 |
| * 2. | Benzoic acid, 2,4-bis[(trimethylsilyl)oxy]-, trimethylsilyl ester | 370 | C16H30O4Si3 |
| 3. | 2,6-DIHYDROXYBENZOIC ACID 3TMS | 370 | C16H30O4Si3 |
| * 4. | 2-TRIMETHYLSILYLAMINO-1-TRIMETHYLSILOXY-1-(3',4'-BIS(TRIMETHYLSILOXY)-PHENYL)ETHANE | 457 | C20H43NO3Si4 |
| 5. | Benzeneacetic acid, .alpha.,3,4-tris[(trimethylsilyl)oxy]-, trimethylsilyl ester | 472 | C20H40O5Si4 |
| 6. | Benzeneacetic acid, .alpha.,3,4-tris[(trimethylsilyl)oxy]-, trimethylsilyl ester | 472 | C20H40O5Si4 |

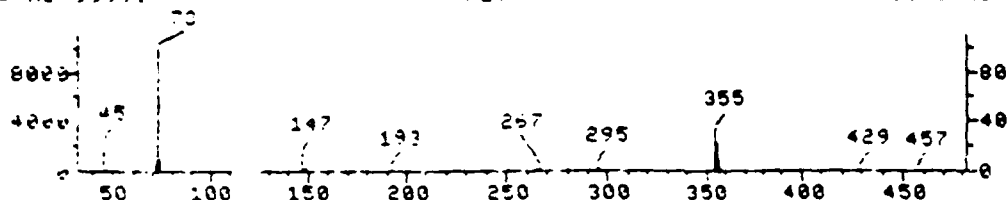
Sample file: JCF229 Spectrum #: 1182
Search speed: 1 Tilting option: N No. of ion ranges searched: 43

Prob.	CAS #	CON #	ROOT	K	OK	#FLG	TILT	%	CON	C_I	R_IV	
1.	32*	37148655	69229	"BIGDB	58	91	1	0	73	53	9	49

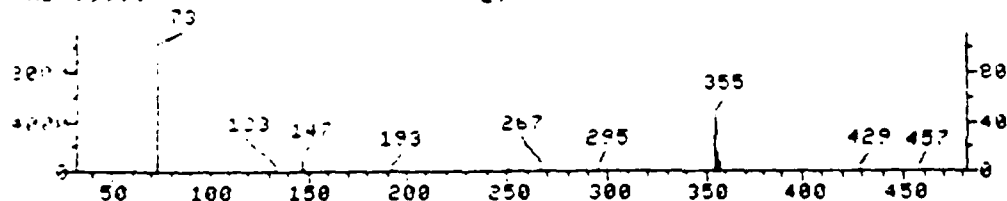
File: LCF229-98022502-1 WHTF Ft. Detrick DF0729, GC Scan 1329
 29.00 min.



File: 91508 Benzeneacetic acid, .alpha.,3,4-tris(trimethylsilyl) Scan 69351
 8.00 min.



File: 91508 Benzeneacetic acid, .alpha.,3,4-tris(trimethylsilyl) Scan 69229
 8.00 min.



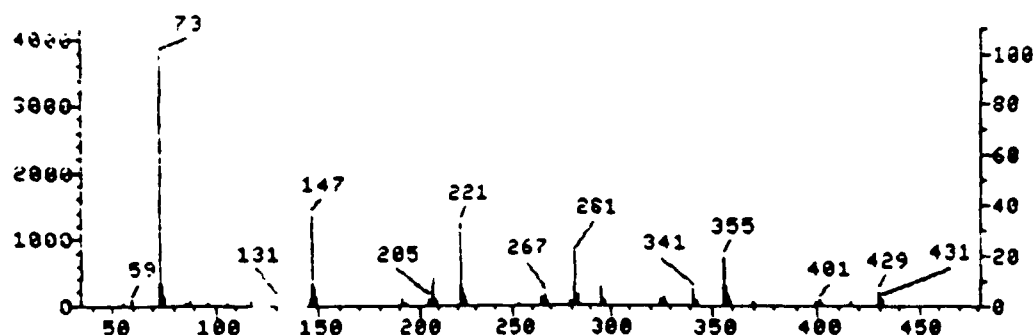
Instrument ID: GC/MS# Analyzed on: 10/29/92 20:18
 Result 7 in FPM results file: LCF229
 Retention Time: 29.00 Area: 52539 Tentative Conc: 11.00
 The unknown area is 28.03% of the nearest internal standard

1. Benzeneacetic acid, .alpha.,3,4-tris(trimethylsilyl 472 C20H40O5Si4
 (oxyl)-, trimethylsilyl ester
2. Benzeneacetic acid, .alpha.,3,4-tris(trimethylsilyl 472 C20H40O5Si4
 (oxyl)-, trimethylsilyl ester

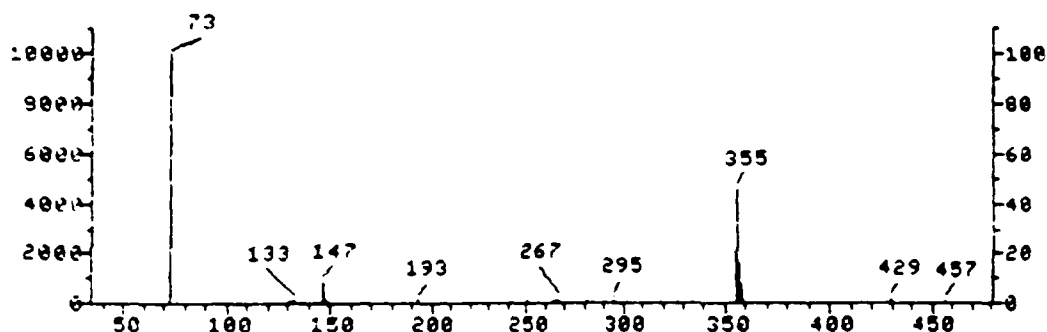
Sample file: >CF229 Spectrum #: 1329
 Search speed: 1 Tilting option: N No. of ion ranges searched: 72

	Prob.	CAS #	CON #	ROOT	K	OK	#FLG	TILT	%	CON	C_I	R_IU
1.	15*	37148655	69351	"BIGDB	20	86	0	0	18	60	3	15
2.	15*	37148655	69229	"BIGDB	20	105	0	0	27	60	3	15

File >CF229 9201022602-1 WHTP Ft. Detrick DF0729, GC/ Scan 1406
69K AB 3777. SUB 30.40 min.



File >81608 Benzeneacetic acid, .alpha.,3,4-tris(trimethylsilyl) Scan 69229
80K AB 9999. FLT 0.00 min.

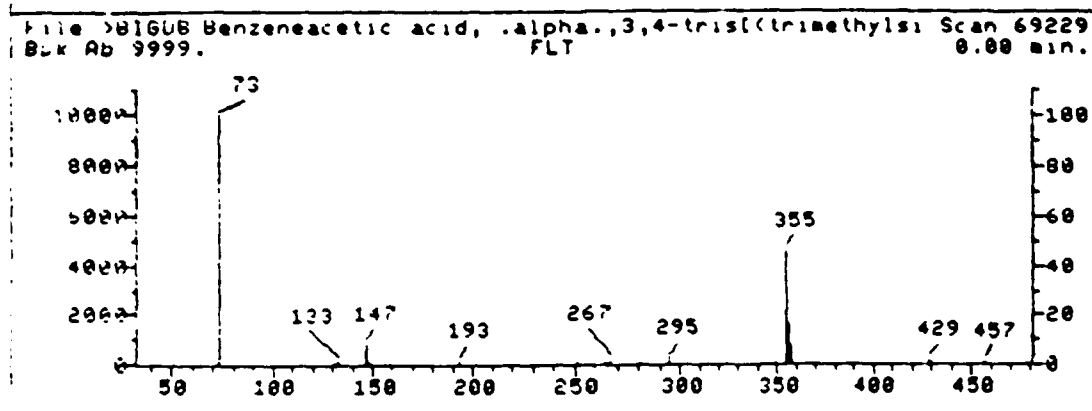
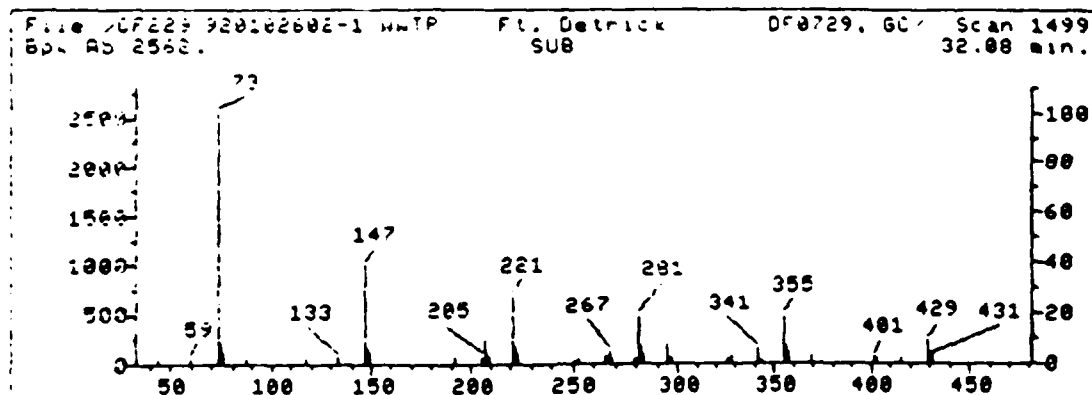


Instrument ID: GC/MS# Analyzed on: 10/29/92 20:18
Result 8 in FBM results file: LCF229
Retention Time: 30.40 Area: 25399 Tentative Conc: 5.00
The unknown area is 13.55% of the nearest internal standard

1. Benzeneacetic acid, .alpha.,3,4-tris(trimethylsilyl) 472 C20H40O5Si4
oxy)-, trimethylsilyl ester

Sample file: >CF229 Spectrum #: 1406
Search speed: 1 Tilting option: N No. of ion ranges searched: 48

Prob.	CAS #	CON #	ROOT	K	DK	#FLG	TILT	%	CON	C_1	R_10
1.	24*	37148655	69229	"BIGOB	31	94	0	0	44	51	7 24

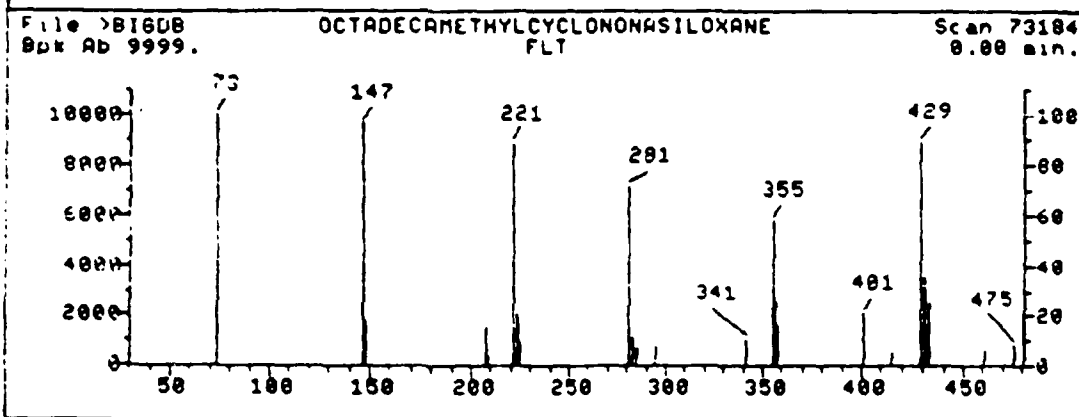
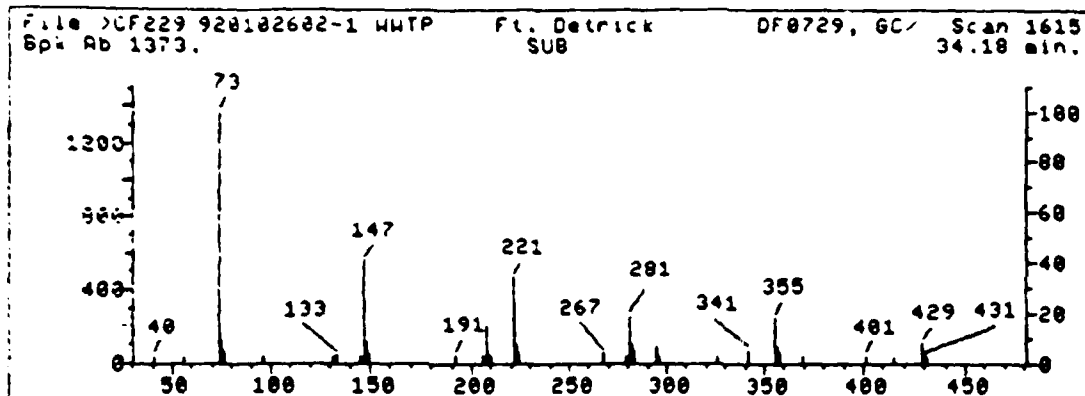


Instrument ID: GC/MS# Analyzed on: 10/29/92 20:18
 Result 9 in PBM results file: LCF229
 Retention Time: 32.08 Area: 36905 Tentative Conc: 8.00
 The unknown area is 19.69% of the nearest internal standard

1. Benzeneacetic acid, .alpha.,3,4-tris(trimethylsilyl 472 C20H40O5Si4
 oxy)-, trimethylsilyl ester

Sample file: >CF229 Spectrum #: 1499
 Search speed: 1 Tilting option: N No. of ion ranges searched: 47

Prob.	CAS #	CON #	ROOT	K	DK	#FLG	TILT	%	CON	C_1	R_1	
1.	21*	37148655	69229	"BIGOB	39	86	0	0	42	57	5	38



Instrument ID: GC/MS4 Analyzed on: 10/29/92 20:18
 Result 10 in PBM results file: LCF229
 Retention Time: 34.18 Area: 25040 Tentative Conc: 10.00
 The unknown area is 23.92% of the nearest internal standard

1. OCTADECAMETHYLCYCLONONASILOXANE 666 C18H54O9S19

Sample file: >CF229 Spectrum #: 1615
 Search speed: 1 Tilting option: N No. of ion ranges searched: 64

Prob.	CAS #	CON #	ROOT	K	OK	#FLG	TILT	%	CON	C_I	R_IU
1.	29	556718	73184	"BIGDB	61	148	2	0	27	32	12 12

Instrument ID: GC/MS# Analyzed on: 10/29/92 20:18

Retention Time: 13.13 Area: 25040 Tentative Conc: 10.00

The unknown area is *****% of the nearest internal standard

This peak is less than 10% of the nearest internal standard.

No library search has been performed on this peak.

Instrument ID: GC/MS# Analyzed on: 10/29/92 20:18

Retention Time: 46.47 Area: 104666 Tentative Conc: 10.00

The unknown area is *****% of the nearest internal standard

This peak is less than 10% of the nearest internal standard.

No library search has been performed on this peak.

APPENDIX 10

RETEST OF 14 HEAVY METALS IN THE
FT. DETRICK WWTP EFFLUENT

APR 29 1993

Client: University of Maryland
Date: April 7, 1993
Project: FT. Detrick WWTP

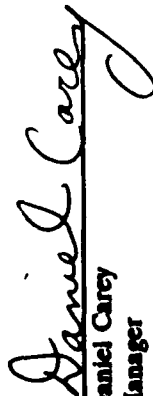
Office: P.O. Box 169 (Cheston Lane)
Queenstown, MD 21658

Contact: Dennis Burton
Phone: (410)827-8056

CASE NARRATIVE

Attached is a copy of the letter sent to Deanna Murphy-Bartram of The Maryland State Department of Health And Mental Hygiene which explains Biospherics deviations from the detection limits specified by the Toxic Substance Analytical Protocol. All other analytical work for this project met QA/QC criteria.

A10-2


Daniel Carey
Manager
Analytical Laboratory

BQL = "Below Quantitation Limit"

Note: Soil and solid waste samples are reported on a dry weight basis.

Client: University of Maryland

Date: April 7, 1993

Project: FT. Detrick WWTP

Matrix: Water

Office: P.O. Box 169 (Cheston Lane)

Queenstown, MD 21658

Contact: Dennis Burton

Phone: (410)827-8056

Lab #	Client ID	Reference Method	Parameter	Quantitation Limit µg/L	Concentration Detected µg/L	Date Collected	Date Received	Date Digested	Date Analyzed
1	FL Detrick WWTP	EPA 200.7	Aluminum	40	45.0	10/26/92	10/26/92	03/18/93	03/19/93
		EPA 200.7	Antimony	20	BQL			03/18/93	03/26/93
		EPA 206.2	Arsenic	5	BQL			03/18/93	03/23/93
		EPA 200.7	Beryllium	5	BQL			10/28/92	10/28/92
		EPA 213.2	Cadmium	0.5	BQL			03/18/93	03/23/93
		EPA 200.7	Chromium	5	BQL			03/18/93	03/19/93
		EPA 200.7	Copper	5	11.9			03/18/93	03/19/93
		EPA 239.2	Lead	5	6.0			03/18/93	03/20/93
		EPA 200.7	Nickel	8	BQL			03/18/93	03/19/93
		EPA 270.2	Selenium	5	BQL			03/18/93	03/22/93
		EPA 270.2	Silver	1	BQL			03/18/93	03/23/93
		EPA 279.2	Thallium	5	BQL			03/18/93	03/24/93
		EPA 200.7	Zinc	5	37.5			03/18/93	03/19/93
		EPA 245.1	Mercury	0.5	BQL			11/30/92	12/01/92

A10-3

BQL = "Below Quantitation Limit"

Note: Soil and solid waste samples are reported on a dry weight basis.

Client: University of Maryland Office: P.O. Box 169 (Cheston Lane) Contact: Dennis Burton Phone: (410)827-8056

Date: April 7, 1993 Queenstown, MD 21658

Project: FT. Detrick WWTP

Matrix: Water

Lab #	Client ID	Reference Method	Parameter	Quantitation Limit µg/L	Concentration Detected µg/L	Date Collected	Date Received	Date Digested	Date Analyzed
1	Ft. Detrick WWTP	EPA 335.2	Cyanide	10	BQL	10/26/92	10/26/92	10/27/92	10/28/92

A10-4

BQL = "Below Quantitation Limit"

Note: Soil and solid waste samples are reported on a dry weight basis.

APR 29 1993


Client: University of Maryland
Date: April 7, 1993
Project: Ft. Detrick WWTP

Office: P.O. Box 169 (Cheston Lane)
Queenstown, MD 21658

Contact: Dennis Burton
Phone: (410)827-8056

CASE NARRATIVE

Analytical work for this project met QA/QC criteria.


Daniel Carey
Manager
Analytical Laboratory

BQL = "Below Quantitation Limit"

Note: Soil and solid waste samples are reported on a dry weight basis.

Client: University of Maryland
Date: April 7, 1993
Project: Ft. Detrick WWTP

Office: P.O. Box 169 (Cheston Lane)
Queenstown, MD 21658

Contact: Dennis Burton
Phone: (410)827-8056

Lab #	Client ID	Matrix	Reference Method	Parameter	Quantitation Limit µg/L	Concentration Detected µg/L	Date Collected	Date Received	Date Analyzed
1	Ft. Detrick WWTP	Water	SM3500-Cr-D	Hexavalent Chromium	10	BQL	04/05/93	04/05/93	04/05/93

A10-6

BQL = "Below Quantitation Limit"
Note: Soil and solid waste samples are reported on a dry weight basis.

APR 29 1993



March 24, 1993

RE: Lab 105

Deanna Murphy-Baxam
Maryland State Department
of Health and Mental Hygiene
Laboratories Administration
P.O. Box 2355
Baltimore, Maryland 21203

Dear Ms. Murphy-Baxam:

As per your phone conversation with Greg Roux on March 12, 1993 I have enclosed a list of Biospherics detection limits which are greater than the limits specified in the Toxic Substance Analytical Protocol. These are the limits that will be reported for those samples submitted by Dennis Burton of the University of Maryland, Wye Research and Education Center. Antimony, beryllium, chromium, zinc have practical detection limits that can be achieved by Biospherics with a 5X concentration of the sample and analysis by ICP. Mercury, Cadmium, Cyanide (amenable to chlorination), Lead, Silver and Thallium limits can be achieved without deviation from their respective methods.

If you have any problems, please give me a call.

Sincerely,

Angela Psenicska
Quality Assurance Coordinator
Environmental and Laboratory Services

Enclosures

☐ Corporate Headquarters
12051 Indian Creek Court
Beltsville, Maryland 20705
(301) 360-3900
Telefax (301) 725-4906/09

☐ Cumberland Regional Office
Crossroads Venture Center
Three Commerce Drive
Cumberland, Maryland 21502
(301) 722-9100
Telefax (301) 722-9100

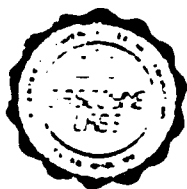
<u>Analyte</u>	<u>Detection Limit $\mu\text{g/L}$</u>	<u>Explanation</u>
Aluminum	40	This limit can only be achieved with a 5X concentration of the sample and analysis by ICP. GFAA is impractical because there is too much interference.
Arsenic	5	Based on our MDL, we can only detect 5 $\mu\text{g/L}$ by GFAA.
Copper	5	This will be achieved by a 5X concentration of the sample and analysis by ICP. GFAA will also only detect to 5 $\mu\text{g/L}$.
Nickel	5	This will also be a 5X concentration and ICP analysis.
Selenium	5	Based on our MDL, we can only detect 5 $\mu\text{g/L}$ by GFAA.

APPENDIX 11

RETEST OF THREE HEAVY METALS IN THE
FT. DETRICK WWTP EFFLUENT

Gasconyne Laboratories, Inc.

JUL 28 1993



SAFETY AND HEALTH
REPORT OF ANALYSIS

Report No. 93-07-219

Report Date: July 21, 1993


Report To: University of Maryland

Page: 1 of 1

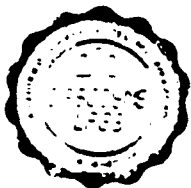
Sample I.D. Submitted Water: Ft. Detrick WWTP Composite, dated
07/12/93 (0930)

	Test Results	Detection Limits	Method	Analyst	Date Test Completed
Arsenic (As)	ND	0.002	EPA 206.2	JAD	07/20/93
Nickel (Ni)	0.008	0.005	EPA 249.2	JAD	07/21/93
Selenium (Se)	ND	0.002	EPA 270.2	JAD	07/20/93

Notes (1) Results expressed as mg/l (ppm).


Thomas A. McVicker
QA/QC Officer

Cascone Laboratories, Inc.



Baltimore, MD 21104-6697

REPORT OF ANALYSIS

Report No. 93-07-219-QC

Report Date: July 28, 1993

Report To: University of Maryland

Page: 1 of 1

QA/QC Data: Metals Analysis: Sample I.D. - Ft Detrick WWTP Composite, dated 07/12/93 (0930)

<u>Element</u>	<u>Matrix Spike Percent Recovery</u>
Arsenic (As)	118
Nickel (Ni)	96
Selenium (Se)	109

<u>Element</u>	<u>Original Result</u>	<u>Duplicate Result</u>	<u>RPD (%)</u>
Arsenic (As)	ND	ND	0
Nickel (Ni)	0.008	0.007	13
Selenium (Se)	ND	ND	0

	<u>LRB</u>	<u>LCS</u>
Arsenic (As), 07/20/93	ND	107
Nickel (Ni), 07/21/93	ND	100
Selenium (Se), 07/20/93	ND	94

Notes: (1) Results expressed as mg/liter (ppm).
(2) RPD-Relative Percent Difference.
(3) LRB-Laboratory Reagent Blank.
(4) LCS-Laboratory Control Sample (percent recovery):


Thomas A. McVicker
QA/QC Officer